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The MONTHLY REVIEW

Published by the

American Electro-Platers' Society

A SOCIETY FOR THE ADVANCEMENT OF THE SCIENCE OF ELECTRO-PLATING

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JULY 1935

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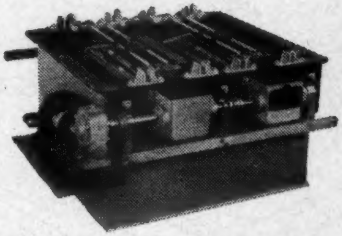

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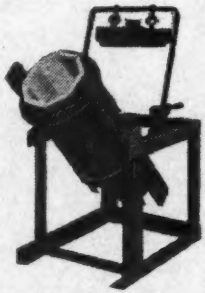

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The MONTHLY REVIEW

Published by the
AMERICAN ELECTRO-PLATERS' SOCIETY

Publication and Editorial Office
90 Maynard St.
Springfield, Massachusetts

VOL. XXII JULY 1935 NO. 7

REPORT OF THE EDITOR OF THE MONTHLY REVIEW for 1934-35

The splendid spirit of optimism that was manifested in the Detroit Convention last year has prevailed during the intervening months so that we can look back with considerable satisfaction on the accomplishments of our Society since the last annual meeting.

The REVIEW has been issued every month and is becoming more and more sought after as the leading publication of the trade both as a scientific and practical guide book. Dr. S. Wernick, Honorary Secretary of the Electrodepositor's Technical Society of London in a letter dated January 17, 1935, writes: "I spent an interesting evening looking through these publications and must congratulate your Society on the excellence of the contents." We have had requests for the REVIEW from the British Non-ferrous Metals Research Association, and are exchanging publications with similar trade journals in France, Germany and Italy. Articles from these are found in the Abstract Section of each MONTHLY REVIEW. In addition to these we have had requests to place the REVIEW in the libraries of the Firestone Tire and Rubber Co., National Oil Products Co., The Parker Pen Co., Pyrene Manufacturing Co., Ltd., of Middlesex, England, J. C. Miller Co., International Business Machines, Corp., International Nickle Co., Inc., and others. All of which proves that the articles published by us are appreciated by the leading manufacturers as well as the platers and are adding great prestige to our Society. In this connection we wish to mention the splendid work of the Chairman of the Educational Committee, Mr. T. F. Slattery, whose articles on the Principles of Chemistry and the Abstract Section have proved very popular and highly interesting to our membership. We sincerely hope that Mr. Slattery can find the time to continue in this capacity as his work alone is outstanding

and places the REVIEW in a class by itself. Each year the papers read at the Educational Sessions of the Convention are more and more interesting and instructive. Looking at this year's program we are sure that the same high standard will be maintained. Mr. Hogaboom, Chairman of this Committee, has arranged a splendid list of speakers with up-to-date topics and is worthy of all the favorable comments that are being said about the educational program. During the year we have been fortunate in having plenty of material each month. Many of the Branch Secretaries have been extremely thoughtful and have sent us the papers read at their annual meetings for publication in the REVIEW. Our Advertisers have stayed with us very consistently and we appreciate their financial aid which has again placed the printing and mailing of the REVIEW on a self-supporting basis. Many favorable comments have been received from our advertisers. In a recent letter from the advertising manager of one of the best known supply houses, he writes "THE MONTHLY REVIEW is the most attractive and interesting periodical in the plating field today." This letter was unsolicited, and the company this man represents has been one of our leading advertisers from the start.

We are rather disappointed that the financial returns from advertising have not added more to the Society's treasury. Evidently our membership as a whole has not taken advertising as a paying proposition very seriously. The proceeds from this source would have been greatly increased if our members would urge the supply house representatives with whom they come in contact to advertise in the MONTHLY REVIEW.

If the Society would create an office appointing a man of Mr. Hogaboom's type to devote his time to the creating of new branches, stimulating branches that are weak and discouraged, laying the claims of our organization with its research and educational qualities before the leaders of our industrial plants and others interested in the electrodeposition of metals, the benefits would be a hundred fold in increased membership, finances and good will. We believe moreover that the salary of such a man would be forthcoming without any great strain on the treasury because of the type of work in which he would be engaged. This idea is practical and should be considered in the near future.

Each of our members now in office, have to depend on the job they hold in some factory for their daily bread. This limits them to the routine work of the president, secretary or Editor's office, which can only be done in their spare time. It is out of the question to expect any or all of these to do more than is now being done, which means that we are leaving a very important part of the Society's work undone.

We mention Mr. Hogaboom particularly in this connection because of the work he has done in the past year visiting the Branches, conferring with the leaders and urging them to greater service and cooperation for the good of the organization.

We are pleased to report that our membership is increasing slowly but surely. The recent drive by our Branches under the leadership of Mr. Underwood, First Vice-President, has been a great help in the last few months. Detroit Branch leads the list according to latest reports with 27 new members, Chicago 13, Newark 8, and Cincinnati 5. Many others have been recruited into our ranks. Several have been reinstated so that our total membership has increased considerably since last year. There are still hundreds of platers in the country who need the A. E. S., the drive should continue until most of these are enrolled.

The Editor extended the President and Secretary of the Master Electroplaters Institute the privilege of using the REVIEW to publish the activities of their organization but so far we have failed to receive any communication after the first exchange of correspondence. This offer is still open.

Our President Mr. Gilbertson has done a splendid job as chief executive of the A. E. S. for the past year. He has not sought the limelight but has worked without sparing himself for the best interests of all. Mr. Thompson, the Secretary-Treasurer has taken up the duties of his office in a painstaking and efficient manner, and has given his best. We have had splendid cooperation during the year from both the President and the Secretary.

Most of our Branch Secretaries have kept the doings of their Branches before the membership in their reports. There are some Branches whose officers show little enthusiasm. New blood in these branches would make a world of difference. The newly elected officers for the coming year would do well to take

cognizance of these indifferent Branches, and start something to revive the spark of life remaining before they become extinct. We can't afford to have any drones in the hive.

We wish to commend the enthusiasm and wide awake spirit of Detroit Branch as manifested in the membership drive.

The following Branch Secretaries have sent full reports of their Societies' activities regularly during the year.

Mr. T. C. Eichstaedt, Detroit Branch.
Mr. J. Hanlon, Chicago Branch.
Mr. Wm. Guilfoile, Waterbury Branch.
Mr. Vernon Grant, Hartford Branch.
Mr. Earl Coffin, Los Angeles Branch.
Mr. Frank J. Marx, Milwaukee Branch.
Mr. Wm. Flaherty, Bridgeport Branch.
Mr. J. R. Elster, Rochester Branch.
Mr. Wm. O'Berg, Cleveland Branch

Anderson, Baltimore-Washington, Boston, Newark, New York, Philadelphia, St. Louis, and Toronto have sent occasional reports while Cincinnati, Dayton, Grand Rapids, Montreal, Providence, San Francisco, Pittsburg, and Toledo have not been heard from at all.

It may not be out of place to remind all Branch Secretaries that Article 5, Section 3 of the Constitution says: "The Branch Secretary shall send to the Editor a report of each meeting and a copy of all papers presented within seven days of the date of the meeting." If this article was lived up to we would have reports from all twenty-five Branches every month.

We believe an earnest attempt should be made by the Supreme Society or a committee appointed by the Executive Committee to find ways and means of increasing the number of Branches. There are many large industrial centers where the influence of the A. E. S. is not being felt. We must keep spreading out if we are to exist as an organization. Maybe we are too modest and don't advertise ourselves enough. Anyhow the field is wide open for missionary purposes.

In conclusion we wish to thank all those members and friends whose articles were read at the Convention and at the Branch meetings, and all others who have had a share in furnishing copy that keeps the REVIEW up-to-date.

We are grateful for the splendid spirit of cooperation shown by our officers and entire membership.

Referring again to our increased membership, this is a most hopeful sign assuring us that we can look forward with more optimism and courage to the coming year, than has been our privilege since the dark clouds gathered around us four years ago. May the 1935 Convention in Bridgeport be all that we expect of it.

We have still many problems to solve. Let us face them honestly without prejudice, and with an open mind.

In an organization such as ours there is no place for a selfish individual. The future of our Society depends on the attitude we take concerning the problems of today. Great changes are taking place in the world about us. Let us as members of the American Electro-Platers' Society have the courage to face the new conditions thrust upon us even if we have to abandon some of the preconceived ideas of the past.

WM. J. R. KENNEDY.

Published by request of the delegates at the first business session of the Convention.

SECRETARY-TREASURER'S ANNUAL REPORT

as read at the Convention at Bridgeport

The accompanying three reports will give you a picture of the progress made in our Society during the past year.

In examining the report on Membership you will note that we have made a gain in members for the first time in two years. This gain on the surface appears to be very slight, but due to the fact that a number of the suspensions recorded should have been made some time ago, they are charged up against the current year. You will note that with but few exceptions all Branches were successful in enrolling new members. Late reports from some of the Secretaries will undoubtedly increase the total.

As to the Branch finances, at the time this report was written, about seventy per cent of the Branches have paid up their accounts in full for the past year. In this group, one Branch in arrears for some time has cleaned up its indebtedness and added new members. It is to be hoped that others will follow its example.

It is a pleasure to be able to report that the finances of the Supreme Society show a decided gain over past years. This

gain is much greater than appears in the final balance, since we have disbursed funds to the amount of Thirteen Hundred Dollars, which has not been required of us in the past. Eleven hundred of this amount was the Society's share in the expense of the Research work for the past year. This sum has been paid out without recourse to the Branches for subscription or assessment.

It has been a pleasure to work with the Executive Board and Branch Secretaries during the past year, and their cooperation has greatly assisted in conducting this office.

Respectfully submitted by your

Secretary-Treasurer,

E. STEEN THOMPSON.

STATEMENT OF THE RECEIPTS AND DISBURSEMENTS AMERICAN ELECTRO-PLATERS' SOCIETY

JUNE 1st, 1934 to JUNE 1st, 1935.

PARTICULARS			
RECEIPTS			
Balance, May 31st, 1934, audit of Treasurer's Account	$2,062.84		
Received from Branches			
Per Capita Tax	2,256.77		
Convention Reports and Supplies	111.44		
	$4,431.05	$4,431.05	
Sale of Convention Reports to Members		306.35	
Sale of Advertising Space in REVIEW		4,023.38	
Received from the Detroit Branch, for Convention Expenses		100.00	
Received from Detroit Branch for Research Fund		150.00	
		$9,010.78	$9,010.78
DISBURSEMENTS			
Printing of the REVIEW		$3,575.24	
Officers' Mileage to Convention		92.61	
Year's Subscription to Research Fund		1,100.00	
Transfer of Detroit's Subscription		150.00	
Expenses of Educational Committee		44.00	
Reporting and Printing Convention Report		587.04	
Branch Supplies		11.55	
Officers' Salaries		250.00	
Expenses of President's Office		45.09	
" " Editor's "		45.80	
" " Secretary's "		297.92	
Space Rental for Members' Exhibit at 1935 Convention		200.00	
Additional 1935 Convention Expenses		67.31	
Debit returned check		25.20	
Bank Tax on three checks, Dec. 1934		.06	
		$6,491.82	$6,491.82

June 1st, 1935, Cash on hand	$2,518.96
Add checks 55, 56, 57, unpaid May 31st, 1935	85.43
Bank Balance, May 31st, 1935	$2,604.39

Accounts receivable May 31st, 1935	
Advertising	$238.00
Due from Branches	210.51
Net cash worth June 1st	$3,052.90

AMERICAN ELECTRO-PLATERS' SOCIETY

COLLECTIONS ON, AND BALANCES OF BRANCH ACCOUNTS RECEIVABLE

JUNE 1st, 1934 to MAY 31st, 1935

Branch	*Per Capita Tax*	*Supplies*	*Convention Reports*	*Balance Due May 31st, 1935*
ANDERSON	$55.66	$0.93	$3.13	$27.71
BALTIMORE WASHINGTON	68.26	1.23	3.17	....
BOSTON	61.96	.93	3.22	....
BRIDGEPORT	134.42	2.16	3.22	....
CHICAGO	349.13	5.10	3.00	....
CINCINNATI	71.94	3.03	3.13	....
CLEVELAND	63.54	1.08	3.13	....
DETROIT	141.77	8.60	3.19	....
DAYTON	70.34	1.08	3.13	....
GRAND RAPIDS	36.76	.63	3.11	....
HARTFORD	74.04	1.08	3.22	....
LOS ANGELES	101.33	1.56	3.32	....
MILWAUKEE	103.44	1.71	3.11	....
MONTREAL	75.71	6.49	7.25	19.32
NEW YORK	159.56	2.60	3.22	....
NEWARK	159.13	2.16	3.22	114.51
PHILADELPHIA	185.77	2.76	9.54	....
PITTSBURGH	39.49	.78	3.22	....
PROVIDENCE	119.79	.78	3.22	33.79
ROCHESTER	102.90	1.56	3.17	....
SAN FRANCISCO	29.40	.48	3.37	15.18
ST. LOUIS	55.66	.93	3.13	....
TORONTO	67.15	1.16	3.33	....
TOLEDO	40.96	.63	3.13	....
WATERBURY	78.77	1.23	3.22	....
	$2,446.88	$50.68	$90.10	$210.51

AMERICAN ELECTRO-PLATERS' SOCIETY

MEMBERSHIP RECORD

JUNE 1, 1934 — MAY 31, 1935

BRANCH	Total Members June 1, 1934	Elected	Reinstated	Gained by Transfer	Lost by Transfer	Suspended	Died	Resigned	Total Members May 31st, 1935
Anderson	28	2				3		2	25
Baltimore-Washington	29	9				2			36
Boston	31	1			1	7			24
Bridgeport	63	5	1						69
Chicago	165	11	2	2		8	3		167
Cincinnati	26	8				15			19
Cleveland	31	1					1	1	30
Detroit	59	25			1	1	1		83
Dayton	33	1							34
Grand Rapids	18					1			17
Hartford	44	4	2			16	1		33
Los Angeles	48	2	3			1		1	51
Milwaukee	49	3				2			50
Montreal	18	1				7	1		11
New York	87	1				11	1		76
Newark	61	8							69
Philadelphia	85	6	2						93
Pittsburgh	19	1	2						22
Providence	27	2				5			24
Rochester	48	2	2			1	1		50
San Francisco	14								14
St. Louis	26	1							27
Toronto	35	2	1			7			31
Toledo	21	3				4			20
Waterbury	39							2	37
	1104	98	17	2	2	84	9	6	1110

WELL DONE, BRIDGEPORT

So many things come into one's mind in trying to chronicle the events connected with the Bridgeport Convention that to give a satisfactory account of all the happenings would take more room than we can spare for an editorial. One thing that stood out prominently was the splendid spirit of good cheer. Everyone was happy and enthusiastic. Not a single untoward incident marred the occasion. The Convention, the exhibits the social events, the weather, and the hotel service, all clicked one hundred per cent. The city of Bridgeport is to be heartily

commended for the hospitality offered, and the newspapers gave us all the publicity we could wish for. We felt positively sorry when the curtain on the four days' proceedings was lowered and the Convention was brought to a close.

The papers read were highly educational and instructive. These will appear in due time in the REVIEW. We hope our finances can be such that the more important slides presented with the papers can be reproduced for publication as the real value of the paper is sometimes lost unless the pictures are presented with it.

The new President, Mr. T. F. Slattery is a young man of whom we can all be proud. He is a worthy successor to the many fine men who preceded him. He deserves our earnest cooperation and hearty support.

The exhibits were a delightful surprise; we hope this feature will be continued each year. The distance between the Hotel Headquarters and the Mosque was not so much of an obstacle as we thought it might be. However, we believe a closer connection between the two if it could be conveniently arranged in the future would be an advantage. Our exhibitors spared neither themselves nor their products in putting on a good show. We believe it was a profitable venture for them and it added a lot to this years' Convention program. Much important business was transacted at the Closing Session. In accordance with the Hartford Resolution, it was voted to admit assistant foremen platers as associate members. Delegates from twenty branches voted in favor of the amendment on a roll call.

This is a step in the right direction and shows progress. A resolution presented by Dr. Blum regarding specifications on plated coatings was also carried which shows still more progress.

Cleveland was given the honor of entertaining the next Convention. This is the city of beautiful women, so all the platers will be there in 1936. Once again we must extend our heartiest congratulations to the Bridgeport Committees who gave us such a wonderful time and to the Chairman, Ray O'Connor, who never lost his pleasing smile all through the trying period of planning and preparation. The consensus of opinion is that the 1935 Convention was the best one yet. With a growing membership, well equipped leaders and a united organization, we should look forward to an even better get-together in Cleveland next year. In the meantime we hope our plater-poet, Mr. Hedley Richards of St. Louis Branch can be prevailed upon to give us another poem as his recent contribution was well received by the 450 platers present.

T. F. SLATTERY, President

CONVENTION HIGHLIGHTS

PRIZE AWARDS

For Papers

The Founder's gold medal was awarded to Mr. W. M. Phillips of Detroit Branch.

2nd Prize.—Mr. W. Castell, Anderson Branch.

3rd Prize.—Mr. A. J. Lupien, Detroit Branch.

For Exhibits

First—Mr. E. G. Stenberg, Chicago Branch.

Second—Mr. W. E. Bancroft, Hartford Branch.

Third—Mr. W. M. Phillips, Detroit Branch.

The Metal Industry Cup was presented to Bridgeport Branch.

The most versatile man in the convention is Walter Meyer. He has discussed every paper so far presented. It appears that if he would attend a fashion show he would be able to make some interesting comments. Speaking about ladies he certainly is a good picker.

Dr. Blum and Mrs. Blum just returned recently from the Faraday Association meeting in London. In his pleasing paper he stated that France and Germany have no society like the A. E. S. but that England has the Electrodepositors Society.

Walter Fraine commented on A. P. Munning's talk and welcomed him back into the industry's activities. He spoke of Mr. Munning's progressive spirit and predicted great accomplishments by him for the future.

Cherry Elected to lead Fellowship Club

At the annual election of the International Fellowship Club H. M. Cherry, Detroit District Manager of the Hanson-Van Winkle-Munning Company was selected as new President for the coming year. The Club's membership includes manufacturers, distributors, and representatives catering to the plating and allied industries. The primary object of the club is to promote the welfare of the plating industry by fair and honest competition. When interviewed, Mr. Cherry said: "It, of course, gives me great pleasure to be so honored by the Club. The past several months has shown a great improvement in business and the whole spirit of the industry seems to be one of looking forward to bigger and finer things. I hope that at the next Convention I can help to sponsor as active and enthusiastic a time as shown at this one."

Mr. Gilbertson, the retiring President, made a good presiding officer and did a fine job in handling the business sessions of the Convention.

The resolutions presented by the Auditing Committee were evidently "thought up" in a hurry, without referring to the minutes of last year's Convention. Incidentally we are anxious to see the Secretary-Treasurer reimbursed for the extra work he was called upon to do in the last two years. Mr. Thompson is performing his duties with a great deal of credit to himself and to the Society. By vote of the delegates, the resolutions were referred to the incoming Executive Board for action.

After Dr. Blum suggested that he was only good for twenty minutes as a speaker without a glass of water, three waiters appeared presently, each carrying a trayful of glasses containing the precious liquid. A great burst of applause greeted the speaker, which he smilingly acknowledged. Our guess is that George Hogaboom had something to do with having the refreshments sent up. Blum and Hogaboom again.

Five members of Toronto Branch presented Mr. George B. Hogaboom with a pen and pencil for the work done by him in connection with their Branch.

Past President Van Derau, although busier than ever since being appointed Works Manager of the Westinghouse Plant at Mansfield, Ohio, attended the Convention, but had to leave early. Van doesn't lose his interest in the A. E. S. We were glad of his counsel and advice at the Executive Board Meeting.

METAL INDUSTRY PUBLISHER HONORED

Mr. Palmer H. Langdon, publisher of the *Metal Industry*, was honored at the Convention by being elected an honorary member of the A. E. S. The valuable assistance given by this publication for so many years to our organization is justly recognized. We hope the pleasant relations existing between the *Metal Industry* and our members will long continue.

We all wish to extend our sympathy to Mr. K. W. Schwartz of the United Chromium Corporation for the accident which he had at the ball game Tuesday. Mr. Schwartz fractured his arm and we certainly hope that the injury will rapidly mend.

The Plater's Society will not forget the financial assistance offered by Mr. Schwartz in behalf of his company, the United Chromium Corporation, at the Detroit Convention last year which started the Research boom, when it looked as though we would be compelled temporarily to abandon the idea.

Bob Leather's movies were enjoyed by the guests at the banquet. Those whose pictures were thrown on the silver screen had a chance to see themselves as others see them.

We had the opportunity of asking some of the exhibitors their opinion as to the desirability of repeating another year. Without exception each one willing to be quoted pronounced the venture a decided success.

We are indebted to the "Convention Extra" which was distributed each day to the delegates by the Hanson-Van Winkle-Munning Co., for some of the news items mentioned. This was a novel feature and elicited much favorable comment.

GUARANTEED — 100%! Try McKeon's "Liquid Sulphur" NOW (if you don't already use it for YOUR oxidizing). A trial order will convince you it is truly "The Oxidizing Agent of Today". SAMPLE Free . . . ASK for it!" Sulphur Products Co., Inc., Greensburg, Pa.

THE METAL INDUSTRY CUP

awarded to the

BRIDGEPORT BRANCH of A. E. S.

for the

BEST EXHIBIT AT THE EXPOSITION OF THE SOCIETY

BRIDGEPORT, CONNECTICUT - JUNE 10-13, 1935

Electrodeposition *of* Tin

INTRODUCTION

By A. L. SHIELDS
Materials and Process Section Eng.
Westinghouse Electric & Mfg. Company
Springfield, Mass.

Read at American Electro-Platers' Society Convention Bridgeport, Conn.

IT IS not intended that this paper will advance any startling theories, processes or applications for the electro-deposition of tin, or discuss any extensive laboratory investigations on the subject. Its purpose is primarily to report some production experiences encountered in the operation of a semi-automatic installation where a uniform, high quality plate is required for coils, shelves and evaporators used in electric refrigerators. The operations of cleaning, plating, final finishing, and inspection are covered by detailed specifications. Several times a day pieces are selected at random immediately after plating and inspected for thickness, color and denseness of the coating. The basis metal is copper or a copper alloy, and the plated finish gives an attractive appearance, and protection against the development of discoloration that would occur if the basis metal were exposed to condensation of atmospheric moisture. A tin plate is relatively a low cost finish and is safe to use in contact with foods. Many metals in contact with food acids develop salts or other compounds which under some conditions are injurious to health. F. C. Blank of the food research section of the Bureau of Commerce, Department of Agriculture, has made some extensive tests of the effect of tin and tin salts on human beings, even going so far as to feed his assistants different products containing tin. As a result, he has approved tin for use on surfaces in contact with food.

Electro-plating evaporators and irregular shapes is preferred to hot tinning mostly for economic reasons. The latter method would be considerably more wasteful of tin, and would not give a uniform appearance. Electro-plating insures a higher purity of tin coating than may be expected by hot dipping where certain impurities can poison the metal. There are, today, at least two types of solutions from which tin has been plated quite successfully on a commercial scale. The acid solution uses stannous

sulphate, sulphuric acid, and other additions. The alkaline solution uses sodium stannate, sodium acetate, caustic soda and other additions which will be mentioned later. The Westinghouse Company is operating an acid bath at the East Pittsburgh Works, and the alkaline bath is used at the East Springfield Works. Later discussion will cover our experiences with the sodium stannate solution. Claims for the acid process are high solution efficiency, with 100% anode corrosion, and therefore low expense for solution maintenance, and a low over-all cost for operation. Some reports indicate low throwing power for the acid bath, although we cannot make a positive statement on a strictly competitive basis. The plate is a good light color, with a smooth texture. Inspection of identical parts plated in each solution shows about the same quality of finish as judged on the basis of porosity and resistance to high humidity at 100°F. The sodium stannate bath provides good throwing power, and this may be a sufficient benefit for certain applications to offset some of its shortcomings. Probably the greatest single disadvantage is the lack of metal replenishing ability, especially when 20% and 30% insoluble anode area is used.

EQUIPMENT

A tank having rubber or lead lining may be used for the acid bath, while a steel tank is suitable for the alkaline solution. The major details of the equipment include a 5000 ampere, six volt generator driven by a synchronous motor. The control panel carries starting equipment and voltmeter, ammeter, and field rheostat for plating generator. The generator is separately excited by current from a small motor generator set. The 3000 gallon plating tank is of welded steel construction. Steam coils and a temperature control and recorder are required. A conveyor which travels around the tank is mounted directly above the solution and the parts are plated during once around the conveyor. Loading and unloading are done at the same station. The cleaning operations proceed parallel with the plating tank and are completed directly opposite the loading station for plating. Tin anodes are suspended from brass bars along both sides and ends and one bar lengthwise in the middle. There are four generator leads to the outside and two leads to the inside anode bars. Individual tin anodes are supported on the con-

veyor to hang between evaporators as they are plated. This brings soluble anodes near the sides of evaporators to give an even plate. The cathode rack, consists of parts including three hooks for gripping an evaporator, an insulated perforated steel anode to which a flexible shunt is connected. In operation this shunt is clamped under a wing nut to a contact finger under spring pressure against the continuous anode bar. For long anode support bars, several bus leads should be used. It is also advisable that current be distributed to a long cathode bus bar at several places. A bus bar which over-heated badly at contacts with two bus leads is now entirely satisfactory with four leads from the generator. Electrical contacts must be watched most carefully. This includes bus bars, drum contact fingers, anode connecting shunts, anode hooks over the support bar, and the easily overlooked contact between the Monel metal hooks and the anodes themselves. A volt meter is easily used for inspection of contact drop. The first pieces plated, particularly if they are large flat surfaces or irregular shapes, should be carefully inspected for evenness of coating. If not satisfactory the anode arrangement should be changed principally with respect to size, shape, and distance from the part to be plated.

It seems preferable to use all soluble anodes, but if this is not practical when anodes are assembled to the cathode racks, steel, nickel or corrosion resisting steel can be used. The more insoluble anode area used the greater the expanse to maintain the metal content of the bath. Cast tin anodes with hooks screwed or cast in are used, but if corrosion of contact between the hook and the anode occurs, an anode will coat over with black stannous tin. If a large number is thus affected, the solution will turn dark due to lack of oxidation. For this reason some consideration is being given to ball anode holders, but the large area of iron exposed may be objectionable or possibly an advantage. The cathode rack should be insulated or designed to avoid stealing current from the work, and on high production a waste of metal.

For best control of the coating thickness on parts plated with inside anodes close to the cathode, and outside anodes some distance away, it is recommended that two generators with

separate controls be used to feed current to the two sets of anodes respectively. This equipment will aid in a more even distribution of the plate and probably a more uniform color can be obtained. Shadows or discolorations are most likely to result when high current density is used with anodes close to the work. Under these conditions the plate is rough with poor light reflection.

It is well to coat the bus bars for moving contacts with a high temperature grease, as the alkali fumes will corrode and insulate the contact surface. All copper and brass bars should be heavily varnished when the equipment is installed.

PLATING CONDITIONS

Satisfactory plating can be accomplished within a wide range of the different variables. Once suitably balanced conditions are established, it is wise to maintain that balance, and the closer the better if a high rate of production is expected. The conditions to be watched most closely are:—

(a) Cleaning
(b) Bath composition
(c) Anode appearance and corrosion
(d) Anode to cathode ratio and current densities
(e) Bath temperature
(f) Plating time and thickness of deposit
(g) Rinsing

All of these considerations should receive at least daily attention, as it is much easier to keep the process under control, than to bring it back from an unbalanced condition. The operator or chemist in charge must be aware of probable consequences should any one of the set conditions vary, and either restore it to its proper value, or carefully adjust the other controllable factors to maintain balanced operations.

Cleaning before plating tin is just as important as cleaning for plating any other metal. All evaporators are heated for strain relieving which produces a light oxide coating. This film is readily loosened by a 5 to 10 minute immersion in a hot red dip solution composed of 10% sulphuric acid plus 1½ ounces of sodium dichronate per gallon. Thorough rinsing is followed

by a 5 to 10 second dip in a cool bright dip acid mixture. It is essential that all traces of this acid be removed before the immersion in sodium cyanide which is followed by a cold water rinse just before plating. The basis metal and brazed joints must be free from oxide, acid, brazing flux, or carbon from the torch flame. The solution composition in use consists of sodium stannate 6 to 12 and sodium hydroxide 1.75—2 25 ounces per gallon respectively. If lower caustic is used the insoluble iron anodes will rust badly. Sodium acetate is present in amounts at least equal or probably double the caustic content although no recent test has been made. Carbonates exist in large amounts, with apparently no serious effect on the plating efficiency. Hydrogen peroxide is usually added when plating is started after a shut down. Production can be started with a new solution containing two ounces of sodium stannate and two ounces of sodium hydroxide per gallon. Tin concentration will increase, and free caustic will diminish. It is then necessary to analyze the bath hourly for a time to determine additions required for stabalization of operation. A new solution may also be made using 24 oz. sodium stannate, and $\frac{1}{4}$ oz. of sodium acetate per gallon.

Regardless of starting solution composition, routine analyses for metal and caustic contents should be started at once, and results plotted along with electrical data.

When uniform production is established, it is quite probable that dissolved stannate additions will regularly be required. The result will be a gradual increase of free alkali which can be controlled with additions of glacial acetic acid, diluted with about 4 parts of water. Additions should be made only as determined by chemical tests. Eventually high concentration of carbonates and acetates will occur. We have operated at a Baume gravity of 27.5 but found it difficult to dissolve stannate in this solution, the metal content dropping below 2.00 oz. per gallon. When this condition develops the metal should be plated out and the solution scrapped. The solution may be chilled slowly to about 35° F and the undesirable salts removed as crystals.

The bath composition is no doubt more easily controlled if all tin anodes are used, as insoluble anodes reduce the effective area from which tin is obtained to replenish the solution. Evaporators of an open end box type require an internal anode, and for various reasons perforated sheet steel is used. These anodes constitute about 33% of the total anode area. A typical evaporator will have 6¼ sq. ft. total area including a shelf. There is 3.75 sq. ft. on the inside and 2.46 sq. ft. on the outside surface. An evaporator plated with the internal anode disconnected gained 26.2 grams (.00024" thickness) and when plated with the anode connected the gain was 61.7 grams (.00058" thickness). Thus the insoluble anodes representing 33% of the total anode area are responsible for about 58% of the total tin deposited. A rough check from stores department records for several months consumption of sodium stannate and pure tin anodes shows that the anodes supplied 48% of the tin deposited.

The solution temperature is quite an important consideration, and at times the thickness of plate may be controlled by changing the temperature. At a temperature of 160° F we have observed a ratio of about 12 to 14 amps per sq. ft. for each ounce of free caustic to give good soluble anode conditions. This point should be verified if possible, to establish whether any definite ratio can be expected for best results. At present, the amount of anode surface, or the number of anodes in solution is judged largely by their color. A yellow green is desired or a light gray is not objectionable. A black loosely scaled surface indicates too low a current density, or too high a caustic content. A brown color indicates the reverse of these conditions. Generally, the color of anodes can be maintained a yellow green by altering their number or surface area as required, plus control of the free caustic.

It is important that the plating time and thickness of deposit be controlled in order to guarantee production schedules, and the protective value desired for the intended service.

Rinsing the parts after plating requires sufficient removal of the plating solution to insure against staining along edges and in corners where the final draining takes place.

Summarizing the plating conditions the following specifications are set up:

Sodium stannate	6 to 12 oz. per gallon
Sodium hydroxide	1.75 to 2.25 oz. per gallon
Acetic acid	As required by analysis
Hydrogen peroxide	As required for initial oxidation
Temperature	160 — 170° F
Ratio Anode to Cathode Area	0.9 to 1.0
Anode Current Density	25 to 30 amp. sq. ft.
Cathode " "	20 to 25 amp. sq. ft.
E. M. F.	3.5 — 4.5 volts
Plating time	30 to 35 minutes
Volume of solution	3000 gallons
Insoluble anode area	66 sq. ft. of sheet steel
Soluble anode area	128 sq. ft. plus or minus
Unit capacity	60 per hour.

CONTROL TESTING

Successful results are directly dependent upon careful control not only of the bath composition, but also of all related factors, such as temperature and current densities. It is wise to have one person definitely responsible for all the details of control over the process and equipment. Poor housekeeping and unreliable equipment will undo the work of the finest chemist, so the analyst is responsible to see that all conditions are maintained in first class order. This does not mean that the solution control is difficult, although it may be considered critical.

The solution is sampled daily, and tested for metallic tin and free caustic. No tests are made for acetates or carbonates. The determination of metallic tin is as follows:

(a) Pipette 5 ml. of filtered sample into a 500 ml. Pyrex Erlenmeyer flask.
(b) Add 200 ml. of 1:1 hydrochloric acid.
(c) Add 10 ml. saturated sodium bicarbonate solution.
(d) Add approximately 2 grams of iron powder.
(e) Immediately close the flask with a 2-hole rubber stopper. One hole to be stopped with a glass rod, and one hole to contain a bent glass tube which will dip into a 50 ml. beaker containing saturated sodium bicarbonate.
(f) Heat the flask gently, (to boiling if necessary) until the reaction is completed, requiring 15 to 20 minutes.
(g) Immerse the flask in running water to cool allowing the bicarbonate solution to be drawn into the flask through the glass tube thus preventing access of air.
(h) Add quickly, 5 ml. of soluble starch solution and immediately restopper the flask.
(i) Remove the glass rod in the stopper and titrate through the stopper using a standardized iodine solution.
(j) Calculate tin (or sodium metastannate if desired) and report as ounces per gallon. ml. I solution x 200 x .1235 x I equivalent = oz. per gal.
(k) Check iodine factor every two weeks or more often if required and date the solution so as to maintain the accuracy of tests.

The iodine solution is standardized as follows:—

(a) Dissolve 20 grams CP potassium iodide in as little water as possible.
(b) Add 12.7 g CP iodine, increasing the volume of water as little as possible until solution is completed.
(c) Dilute to 1 liter in a volumetric flask.
(d) Dissolve exactly 5.7900 grams CP tin in 150 ml. of boiling CP concentrated hydrochloric acid.
(e) Cool, transfer to a volumetric flask, and dilute to one liter.
(f) Titrate 25 ml. of the tin solution with the iodine solution using 5 ml. soluble starch as indicator.
(g) 1 ml. I = $\frac{25 \times .00579}{\text{ml. Iodine solution used}}$ = grams tin
(h) 1 ml. I = tin equivalent x $\frac{266.74}{118.70}$ = $Na_2 SnO_3 3H_2O$

The determination of free caustic is as follows:—

(a) Pipette a 5 ml. filtered sample into a 250 ml. beaker.
(b) Dilute to about 100 ml. with distilled water.
(c) Add 50 ml. barium chloride solution (50 g. per 1.)
(d) Stir, let stand 15 minutes, filter through No. 42 Whatman filter paper or equivalent.
(e) Test the filtrate with a small quantity of barium chloride and if necessary add more barium chloride and reprecipitate.
(f) Wash precipitate thoroughly passing washings into the filtrate. Reject the precipitate which contains carbonates and stannates, the acetates being soluble was washed into the filtrate.
(g) Dilute filtrate with distilled water to 200 ml. in a 400 ml. beaker.
(h) Add 5 drops thymolphthalein solution.
(i) Titrate with N/4 hydrochloric acid until the blue color just disappears.
(j) 1 ml. N/4 HCl = .009117 g/ml.
1 ml. N/4 HCl = $\frac{.009117 \times 40}{36.46}$ = .01 g. sodium hydroxide.
1 ml. N/4 HCl = .01 x 200 x .1335 = .267 oz./gal.
(k) Standardize the acid frequently to maintain the accuracy of test.

Other methods of analysis may be used, but the above appear to have been quite satisfactory in our experience. Once the metal and caustic values are known the chemist calculates the additions to be made, and gives detailed instructions for each shift foreman to follow. All additions of salts must be in the completely dissolved conditions.

Sodium stannate may be dissolved in cold water or in plating solution drawn from the tank. Glacial acetic acid is diluted with 3 to 4 volumes of water and distributed below the surface of the plating bath for reduction of the free caustic. Hydrogen peroxide, 100 volume, amounting to about 1/20 the volume of the diluted acetic acid used may be added with the acid.

Some attention should probably be given to the surface tension of the solution. Generally a foam covers the bath when it is electrolized, and this foam prevents escape of carbonates and caustic which heavily encrusts equipment, and the vapors may temporarily irritate the respiratory passages of the operators.

The control chemist also inspects all cleaning, bright dipping, rinsing, brushing, and lacquering operations in the evaporator manufacturing section.

INSPECTION

Following the rinsing and forced drying, the surface is inspected for appearance and the outside is wire brushed. After drying and while brushing the parts must be handled with clean cotton gloves. The brushing is followed by dipping the evaporators in a clear lacquer of low solids content. The brushing brightens the surface so that light marring encountered in subsequent assembly handling is obscured. The lacquering reduces the tendency to finger stain. During all of these operations a visual inspection for color, smoothness, and signs of a thin coating is made. Several times daily, an inspector weighs an evaporator before and after plating to insure that at least the minimum weight of coating is being obtained. This information is immediately available to the control chemist so that plating conditions can be changed if too heavy or too thin a coating is formed.

What thickness of tin plate is required for refrigerator parts exposed in a food compartment? What thickness of coating will give protection for the long time guarantees on the units? These are vital questions, which experience alone will solve. However, the first safe assumption appears to be that the coating shall be of uniform thickness and as free as possible from sponginess and microscopic pores. Accellerated tests are valuable for quality control but the results cannot be used to safely predict the probable life of a finish. Tests for thickness are easily made by stripping a known area and calculating the loss in weight into terms of thickness. Sponginess and porosity tests are more of a problem. High temperature, high humidity and salty atmospheres will eventually break down the finish to the basis

metal, but the time required is much too long for production control testing. Immersion tests in corroding liquids are more rapid but the test solution is likely to dissolve the reaction products and the evidence of attack is thus removed, or difficult to observe. Our Research Laboratories have proposed that inspection for localized defective areas of an electroplate can be conveniently made in a selected corroding atmosphere. For testing tin plated copper alloys, the parts are placed in an air tight box over ammonium hydroxide. It is best to have the parts chilled several degrees below room temperature at the start of exposure. The ammonium hydroxide container may be set in a pan of hot water beside or under the test specimens, and covered immediately. A particularly poor quality of plate will show greenish or bluish colored areas in a few minutes to a half hour, while from 4 to 16 hours are required to detect points of weakness on a very durable plate. Coatings can be applied which will withstand 48 hours or more exposure without breakdown. Considerable correlation of data on this test remains to be done, but the procedure offers much promise for a rapid control test. Following any period of exposure to ammonium hydroxide vapor, the parts may be subjected to an atmosphere of ammonium sulphide for two to five minutes to accentuate the color of areas attached. The sulphide darkens corroded areas, and careful judgment of true failure is necessary when the sulphide vapor is used.

Time does not permit a further discussion of inspection tests. What is the answer to the question on thickness of coating? It seems to depend on the degree of porosity. If a non-porous plate .0003" thick can be assured, this is probably sufficient. It should be noted that two reliable sources of information suggest .0006" as the pin hole free coating. Another authority says, probably the same for a nickel plate, or .0010" thickness. So far in our experience a standard of .0005" thickness is the aim. This gives some margin of safety should temporary conditions produce a thinner plate. The average thickness of coating on Westinghouse evaporators lies between .0005 and .0006 inches.

CONCLUSION

The cost of all materials involved for cleaning, plating, and

lacquering averages 2.655 cents per square foot. Although this does not include cost of water and wire brushes for finishing, the figure does not appear excessive for expense materials. Many problems have been encountered, and successfully overcome, and there is no use denying the fact that unforeseen obstacles will appear. The success achieved to date gives assurance that operations, control, quality, and costs will be gradually improved in the future.

Electro tin plating was established on a high production schedule when no one in the local organization had had commercial experience with the application of this finish. This is mentioned to show that the process is not too difficult to manage and if there is a demand for an electro tinned finish, there should be no great hesitation about its adoption.

ACKNOWLEDGMENT

Valuable suggestions and help have been received from Mr. Geo. B. Hogaboom and Mr. F. F. Oplinger. In addition to my immediate associates, Mr. W. J. Kennedy has contributed much practical assistance on the every day problems that are encountered in a plating department.

For the benefit of those who may be further interested in electrodeposition of tin the following papers should be carefully studied:

"*An Efficient Electrotinning Process*" by F. F. Oplinger
The Metal Industry, 1931, **29**, 529.

"*Electrodeposition of Tin from Alkaline Solutions*" by L. Wright and F. Taylor
Journal of Electrodepositors Society, 1932, **7**, 103.

"*Electro-tin Plating*" by R. E. Maeder
THE MONTHLY REVIEW, (A.E.S.) 1932, **7**, 12.

"*The Electrodeposition of Tin from Sodium Stannate Solutions with the Use of Insoluble Anodes*" by A. W. Hothersall, S. G. Clarke, and D. J. Macnaughton.
Paper read before the Electrodepositors' Technical Society, Feb. 22, 1934.

"*Notes on the Analysis of Alkaline Tin Plating Solutions*" by M. R. Thompson.
THE MONTHLY REVIEW (A. E. S.) 1934, **10**, 16.

DISCUSSION

CHAIRMAN SLATTERY: Are there any questions?

MR. PROCTOR: I congratulate the author of this article. It is a splendid article, and I am sure that if the details which have been given are followed out, anyone can electro tin plate. He did not make reference to what I did on tin plating. Because I am the author of the sodium stannate solution, I want to give you some idea of how it came to be used in the refrigerating industry.

When Frigidaire started to make refrigerators, they bought hot coated tin copper. They formed the coils. The pans of cube receptacles were made out of steel. When they got the entire job done, they tried to hot tin it and failed in getting the desired results. Previous to that the Vulcan De-Tinning Company, of Sewaren, New Jersey, had developed sodium stannate for commercial tin plating. They had done considerable experimental work themselves, but they did not understand what was required in electroplating with tin solutions.

The R. & H. Chemical Company became the sole agent for the Vulcan De-tinning Company for the sale of sodium stannate in the United States and Canada. Then it was put up to me to find a field in which to use sodium stannate, and, of course, I had quite a problem. As you all know, I have been more or less connected with the plating industry for a few years. I knew practically all of the contact solutions and all the immersion solutions, but they did not use sodium stannate.

One day Harry Williams, the chief metallurgist of the Frigidaire Company, came to New York. He brought their problem with him. He brought a complete unit with a coil, and so forth, and showed me what they had and what they were trying to accomplish. We sat down and discussed the proposition and I saw the future field at that moment for electro tin plating in the plating industry, and we first installed the sodium stannate solutions in the Frigidaire plant. Of course, I am speaking of these facts because I am a free agent. No one controls anything I might have to say at this time. We worked there for quite some time in perfecting the sodium stannate solution. We used the resinates and the perborates in those solutions. I never

patented what we used, so they are free for anyone to use who might want to use them. We finally produced results. We took the coil and the box together. It was electrically cleaned. After that it went through a bright copper solution. When the bright copper solution covered the solder, it went in the sodium stannate solution, and, so far as I know, those are the results today as they produce them.

Of course, the electro tin solutions passed on into the automobile industry. You know they use it quite considerably in the automobile industry. I still believe there is quite a future for electro tin plating, and I am very pleased to have listened to this paper because it verifies, to a great extent, what I started to accomplish when the matter was turned over to me quite a few years ago. I am pleased to acknowledge the author of this paper.

MR. HOGABOOM: I should like to ask Mr. Shields a question. When he spoke about one and one-half to two ounces of caustic soda, did he mean that was the total caustic, or should that be added to the solution? I do not think that was quite clear in the paper. What is the total content?

MR. SHIELDS: Don't worry about the total caustic content. Free caustic is the only thing we are concerned with. That is covered in the methods of analysis.

Since that question has come up, I might say that we get a direct test for free alkali by precipitating with barium chloride. We precipitate with barium chloride to get rid of all the stannates and carbonates so that we are testing, we think, for the free alkali.

MR. HOGABOOM: I should also like to ask Mr. Shields if he will tell us the cause of rough deposits and how they can be corrected.

MR. SHIELDS: I don't know but what Mr. Hogaboom is getting right back at me because I asked him that question.

MR. PROCTOR: We found that by continuous filtration of the solution we got rid of that.

I just want to say a word about the insoluble anodes. I don't think you can maintain a solution in constant operation without the use of insoluble anodes. It seems the voltage goes

down when you do not have an insoluble anode. I found this to be true several years previously when I installed the first zinc cyanide solution in the Hayes-Wynn Company's plant in Jackson. I think at that time it was going along very nicely. They discarded the sulphate solutions. We were holding the convention at Cincinnati at that time. I got a telegram from the Hayes-Wynn Company saying the cyanide solution had gone to hell and they couldn't do anything with it. Of course, I managed to get there the next morning and they told me their problems. The only trouble was that the voltage was down to a point where they could not maintain the amperage. So they told me about the analysis, how the zinc had gone up in solution. The zinc was being reduced and was not going on the surface of the work.

I went to work and had steel anodes made the same length as the zinc anodes we were using and I had them cleansed, pickled, and cleaned and had the holes drilled so we could put on a double hook. Then I had them put in and carburized, so we got a hard surface. Then we put the anodes in. I think we used about sixty per cent of soluble anodes against forty per cent of insoluble anodes. From that time on we did not have any trouble outside of maintaining the solution. So I think if you are going to operate tin solutions upon an extensive scale, you have to use insoluble anodes.

MR. HOGABOOM: Mr. Shields put it up to me to tell you the story of rough work. We had an amusing incident. One of the things that happens in a tin solution with a large soluble anode area is that the sodium stannite is formed at the anode. This happens to be the only electrolyte of which I know in which the products formed at the anode are not soluble in the electrolyte. Sodium stannite is formed, and that will coat over on the anode as a black sludge. The solution will become a very dark color and the deposit will become as rough as sandpaper. The recommended procedure was to add hydrogen peroxide. At this particular time, hydrogen peroxide was added, about thirteen gallons every eight hours, twenty-four hours a day, six days a week, and there was some noise. It was thought that a study might be made of the anode current density. This was changed

so that the anode area was decreased to the extent that there was enough oxygen given off at the anode so as to oxidize a stannite to the stannate form during electrolysis. After that was done, the solution remained perfectly clear, and, as Mr. Shields stated, the addition of hydrogen peroxide is only necessary at the beginning of the solution, but it is important, as Mr. Shields brought out, to study your anode area, your soluble anode area, in comparison with your cathode area. See that the anodes have a greenish color, and then the solutions will remain clear and you get away from roughness.

MR. A. PEARSON (Western Electric Co., Chicago, Ill.): Mr. Shields mentioned that the acid solution is used in tin plating also. He undoubtedly has done some work in the acid solutions. I understand there is no tendency to form a soluble precipitate in those solutions and that they can be operated at room temperatures satisfactorily. I wonder if he will give us some comments on that.

MR. SHIELDS: I am going to ask Mr. Kelly, from East Pittsburgh, to answer that question. He has followed that work closer than I.

MR. J. F. KELLY (Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.): I am sorry I can not answer the gentleman's question definitely, but we did install the stannous sulphate solution and it worked very satisfactorily for the time that we had it. We got a very uniform, bright deposit. We have not had occasion to use it for the past three or four weeks.

MR. HOGABOOM: Can you deposit tin directly on cast iron?

MR. KELLY: We didn't try that. All we tried was copper and brass parts.

MR. PROCTOR: Did you find the sulphate solution had the throwing power of the sodium stannate solution?

MR. KELLY: I know very little about the throwing power of the stannate solution, but the throwing power of the acid solution is almost nil.

DR. BLUM: There are two short questions that I wish to ask. Mr. Hogaboom has already answered one of them indirectly. I wonder if in the control of the solution analyses are made for stannous tin. You spoke of the total tin content, because that was one of the points brought out also in the English publica-

tions, the necessity of keeping all the tin oxidized to stannous condition. The other question I am asking is about something which I perhaps did not get clear. In connection with the loss of alkali from the spray, if there was no foam on the solution, isn't there an equal loss or an equivalent loss of all the other constituents of the solutions? I was wondering whether, perhaps, that suggestion of getting rid of the alkali by the spray was not just equivalent to throwing away some of your solution.

MR. SHIELDS: That point is very well taken. I am sure it will be quite a problem to work it all out to the finest details, but before we start spending $10 a day for additional salts, we want to find out if it is necessary.

MR. HOGABOOM: I wonder if that is quite correct. Take a brass solution with a lot of spray. A great deal of it condenses and falls back into the solution as carbonates, and in the exhaust system there is very little metal found. It is mostly carbonates. In running for over six months, in testing what was in the exhaust, the metal concentration of the condensation in the exhaust was very slight, which would indicate what I have said. It seems to be different from the spray from chromic acid, which I am quite certain Dr. Blum had in mind in that discussion.

MR. SHIELDS: All we can say about the salts that have escaped from the surface of the solution for the last two months is that they amount to probably several hundred pounds. They have been blown out of the windows. In addition to that, they settled all over the plating equipment and on machines fifty and seventy-five feet away from the plating tank. Our tests have indicated that they are mostly carbonates — probably ninety-five per cent carbonates — that have been coming off. We believe some caustic is coming off at the same time. We don't know just what the ratio of caustic and carbonate is as it comes out of the tank. We found no metal in these salts that were deposited outside of the tank.

MR. HOGABOOM: The caustic would be going off, but it would be oxidized to carbonates; that is, it would be decomposed into carbonates by the atmosphere.

MR. EDWIN M. BAKER (University of Michigan, Ann Arbor, Mich.): Mr. Shields gave the cost per square foot for deposits

half a thousandth of an inch thick. I would like to ask if he has the figure available as to how much of that cost is represented by the actual cost of the anodes.

MR. SHIELDS: Well, I don't know. If we get fifty per cent of the metal deposit from the anode and we have sixty grams of tin on the evaporator and it costs fifty cents a pound you can figure it out very conveniently.

MR. BAKER: I wonder how much that would be increased if the plate thickness were doubled, for example. It certainly wouldn't double the cost.

MR. SHIELDS: No, I don't believe so.

MR. BAKER: The actual cost of the metal on there would be comparable.

MR. SHIELDS: Not the cost of the other operations.

MR. BAKER: If you double the plate thickness, it will be not much over a cent. You probably would not add more than one cent, I would imagine, per square foot. You would raise it around three point five cents for a heavier plate.

MR. COSGROVE: I have just a short question to ask about something which Mr. Shields mentioned. He mentioned some attention should be paid to surface tension. Were there any quick tests developed?

MR. SHIELDS: No quick tests have been mentioned. That idea was thrown in, perhaps, for the laboratory man, if he is interested in that. I mentioned the surface tension as accounting for the troubles you get into with all these carbonates coming off, and if you keep them in there, you are going to get into trouble also. Maybe you get a surface tension that will hold the metal in solution and let the undesirables escape. That is hardly possible, however.

MR. A. G. SPENCER (Chevrolet Motor Co., Flint, Mich.): It may interest some of the members of the Society if I should say a few words about the experience of the Chevrolet Company in deciding upon the proper equipment to install and the type of plating solution to use for plating their pistons, cast iron pistons. We had to go into production last year in tin plating our pistons and we had to take into consideration the cost of equipment, the floor space involved, the cost of operating, and the type of deposit obtained. After seeing some of the other

tions, the necessity of keeping all the tin oxidized to stannous condition. The other question I am asking is about something which I perhaps did not get clear. In connection with the loss of alkali from the spray, if there was no foam on the solution, isn't there an equal loss or an equivalent loss of all the other constituents of the solutions? I was wondering whether, perhaps, that suggestion of getting rid of the alkali by the spray was not just equivalent to throwing away some of your solution.

MR. SHIELDS: That point is very well taken. I am sure it will be quite a problem to work it all out to the finest details, but before we start spending $10 a day for additional salts, we want to find out if it is necessary.

MR. HOGABOOM: I wonder if that is quite correct. Take a brass solution with a lot of spray. A great deal of it condenses and falls back into the solution as carbonates, and in the exhaust system there is very little metal found. It is mostly carbonates. In running for over six months, in testing what was in the exhaust, the metal concentration of the condensation in the exhaust was very slight, which would indicate what I have said. It seems to be different from the spray from chromic acid, which I am quite certain Dr. Blum had in mind in that discussion.

MR. SHIELDS: All we can say about the salts that have escaped from the surface of the solution for the last two months is that they amount to probably several hundred pounds. They have been blown out of the windows. In addition to that, they settled all over the plating equipment and on machines fifty and seventy-five feet away from the plating tank. Our tests have indicated that they are mostly carbonates — probably ninety-five per cent carbonates — that have been coming off. We believe some caustic is coming off at the same time. We don't know just what the ratio of caustic and carbonate is as it comes out of the tank. We found no metal in these salts that were deposited outside of the tank.

MR. HOGABOOM: The caustic would be going off, but it would be oxidized to carbonates; that is, it would be decomposed into carbonates by the atmosphere.

MR. EDWIN M. BAKER (University of Michigan, Ann Arbor, Mich.): Mr. Shields gave the cost per square foot for deposits

half a thousandth of an inch thick. I would like to ask if he has the figure available as to how much of that cost is represented by the actual cost of the anodes.

MR. SHIELDS: Well, I don't know. If we get fifty per cent of the metal deposit from the anode and we have sixty grams of tin on the evaporator and it costs fifty cents a pound you can figure it out very conveniently.

MR. BAKER: I wonder how much that would be increased if the plate thickness were doubled, for example. It certainly wouldn't double the cost.

MR. SHIELDS: No, I don't believe so.

MR. BAKER: The actual cost of the metal on there would be comparable.

MR. SHIELDS: Not the cost of the other operations.

MR. BAKER: If you double the plate thickness, it will be not much over a cent. You probably would not add more than one cent, I would imagine, per square foot. You would raise it around three point five cents for a heavier plate.

MR. COSGROVE: I have just a short question to ask about something which Mr. Shields mentioned. He mentioned some attention should be paid to surface tension. Were there any quick tests developed?

MR. SHIELDS: No quick tests have been mentioned. That idea was thrown in, perhaps, for the laboratory man, if he is interested in that. I mentioned the surface tension as accounting for the troubles you get into with all these carbonates coming off, and if you keep them in there, you are going to get into trouble also. Maybe you get a surface tension that will hold the metal in solution and let the undesirables escape. That is hardly possible, however.

MR. A. G. SPENCER (Chevrolet Motor Co., Flint, Mich.): It may interest some of the members of the Society if I should say a few words about the experience of the Chevrolet Company in deciding upon the proper equipment to install and the type of plating solution to use for plating their pistons, cast iron pistons. We had to go into production last year in tin plating our pistons and we had to take into consideration the cost of equipment, the floor space involved, the cost of operating, and the type of deposit obtained. After seeing some of the other

plants and studying their experiences on the stannate bath, we finally decided to install the acid tin solution. We have been operating now since last October. We plate from six-tenths of a thousandth to one-thousandth of an inch in thickness of tin in about eighteen minutes. Previous experience at other plants, I believe, was that the stannate solution requires about fifty-five minutes to put on the same depth of plate. We found that we could not get an adherent deposit of the tin from the acid solution directly upon the cast iron, and we therefore had to put a strike from the stannate bath. This gave a very thin film of adherent tin directly on the cast iron and then the tin would deposit on that from the acid solution and give a very adherent, fine-grained, rather hard deposit. At least, it seemed to be harder than that from the sodium stannate bath.

The question of throwing power didn't enter into the matter very much because we did not want to deposit the tin on the inside of the cast iron piston, nor into the piston pin holes. We had to remove the tin from the top of the piston and from the ring grooves after plating. We found that was a more efficient way under our conditions than to put a cap on the top of the piston to prevent deposition direct on the head.

Our costs, we believe, are lower than those using the stannate bath. From the figures given here this morning, I think our cost per square foot — I would say just from memory — is about one-half that of the stannate bath; that is, material costs less. The time has been reduced and is less than a half of that required for the stannate bath. We are very well satisfied with the stannate bath as applied to pistons. Where a small installation was necessary in a still tank, we found it was quite satisfactory to use a cleaner tank, and alkali cleaner, with a few tin anodes in there, and we got a tin cleaner strike in one operation. That worked very satisfactorily in some of the other units where they didn't have sufficient production to put in a full automatic tank, and they have been running now in one plant that I know of since last July. I thought that might be interesting to the other members. (Applause)

MR. HOGABOOM: Mr. Shields, would it require fifty-five minutes to deposit a half-thousandth from the stannate solution?

MR. SHIELDS: Not on our job as we are operating today.

MR. HOGABOOM: How much do you do it in?

MR. SHIELDS: Not over thirty-five, as we are getting about six-tenths of a thousandth in thirty-five minutes, and a half-thousandth in thirty minutes. Incidentally, I don't believe the gentleman who just spoke would agree that they should make a direct comparison of the two processes in these two cases because the type of plate you want in one case is entirely different from what you want in the other.

MR. R. E. MAEDER (Frigidaire Corp., Dayton, Ohio): I just want to add to what Mr. Spencer has said about the acid tin. We have experimented with acid tin in our plant and we have not been able to get the throwing power out of the acid tin that we do with the sodium stannate, on our commercial evaporators, which are a tinned-tube affair. We plate in sodium stannate solutions, but we were unable to plate those evaporators in the acid tin, although the efficiency of the acid tin is considerably greater on the cathode, and the anode, too, for that matter.

MR. M. R. THOMPSON (Washington, D. C.): In making a determination of free caustic, I found that strontium chloride gave much more granular precipitate that was easier to filter off. I wonder if Mr. Shileds has tried that.

MR. SHIELDS: We haven't been able to give time enough to investigate that process. We are awfully glad to have that paper of yours and will be glad to pay some attention to it later.

I want to say and have it understood by everyone here that this paper as given is not intended as a last word on tin plating at all. The theme of the convention is "how it is done" and that is just about what you got in my paper. I think the discussion indicates the subject is full of possibilities for further investigation, and the paper was presented merely with the idea that it would stimulate discussion and the presentation of other papers on the subject. If certain large installations are going to be continued in use, we ought to get together and get the most efficient procedure to follow. (Applause)

AUTHOR'S CLOSURE

Many interesting and important points have been mentioned in the oral discussion. The author appreciates all these remarks

and heartily thanks those who participated in the discussion for helping to clarify some of the general statements in the paper.

Mr. Spencer's report on the use of the acid tin solution shows that this bath has real possibilities. Messrs. Maeder and Kelley report one of its limitations. Thus it appears that a choice of one or the other is largely to be determined on the basis of the throwing power desired, with the overall operating cost favoring the stannous sulphate solution. It would seem advisable for a contemplated application to investigate both processes paying more attention to the quality of plate and its distribution on the work, than to the relative operating costs.

Dr. Blum asked if in the control of the solution, analyses are made for stannous tin. The answer is that this has not been found necessary. Stannous metal in the plating bath is very small in amount under proper operating conditions. If tests are made the sample should be analyzed immediately on the job, and under controlled non-oxidizing atmosphere.

Messrs. Blum and Hogaboom commented on the author's remarks about loss of bath constituents by the surface spray. We reported that the salts deposited from this spray analyzed approximately 95% carbonates, and that we found no metal in them. A more careful test shows these salts to contain about 5 to 6% of tin. A test on some crystals frozen out of the plating solution shows 3.96% sodium stannate. These losses of metal are not considered excessive. The spray may be disposing of the bath constituents in about the same order as would occur by chilling the solution slightly above 32° *F.*

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"Zinc Plating"

Paper delivered before the American Electro-Platers' Society, Chicago Branch on April 13, 1935

By MR. J. F. CALEF

THE experience gained with the use of a number of zinc solutions for the practical electro-deposition of zinc will, we believe, be of interest to many concerned with corrosion resistant coatings. Of greater interest, we believe, should be the possible extension of the use of a zinc deposit having a very pleasing color, and one that will retain that color for indefinite periods. This paper, is therefore, prepared with those points definitely in mind, and at the request of the Librarian of the Chicago Group of the American Electro-Platers' Society.

Our problem is to protect the small and vari-shaped iron and steel articles that are used in the manufacture of telephone apparatus from corrosion of atmospheric agencies throughout the entire world. Furthermore, the parts must be plated originally with a pleasing and uniform color and this must be retained for a considerable period of time. Many of the parts which go to make up the telephone exchange equipment are placed in a somewhat conspicuous place in glass enclosed cabinets and hence should present a good appearance. On the other hand, telephones and also exchange equipment are apt to be placed in severe exposures where resistance to rusting is of prime importance. We, therefore, have a dual purpose to fulfill in the electroplating of our apparatus parts.

In the earlier days most of the iron and steel parts were nickel plated with an underlying coat of copper. With the knowledge of plating and especially its control severely limited in those early days, it was only natural that we experienced considerable trouble with rusting of the equipment. In order to overcome the rusting of these parts, practice was turned to electroplating of zinc with zinc sulfate solutions.

Zinc electro-deposited from most zinc sulfate baths is quite bright in color and unless heavy deposits are desired little difficulty is encountered. However, because of the irregular shape of most of the parts and severe dimensional tolerances,

it was a very difficult job to produce bright, smooth, uniformly distributed zinc deposits. The earlier solutions were composed in general as follows: $ZnSO_4.7H_2O$ — 35 oz. per gallon, A12 $(SO_4)_3$ — 2 oz. per gallon, NA_2SO_4 — 4 oz. per gallon .015 oz. gum arabic. Slight acidity was maintained with H_2SO_4CP.

Numerous experiments were carried out in order to produce smoother and more uniformly distributed deposits with $ZnSO_4$ solutions. These were badly needed because of the large number of parts having pileups of zinc at the projections and consequent rejections because of inability to meet dimensional requirements. A very large number of addition agents were tried out — gum arabic was used for a long time. Gum arabic was also found to produce vari-colored patterns after parts had lain in the stockrooms for some months, and hence, was considered objectionable. We finally arrived at a solution having the following approximate formula.

$ZnSO_4.7H_2O$	50 — 60 oz. per gal.
NaCl	3 — 5 " " "
Grape or Corn Sugar	.75 — 1.5 oz. per gal.
Temp. 65° — 95° F	C.D. approx. 20 amp. sq. ft.

This solution was used for both, still tanks and barrel operation, a slightly higher metal content being used in the barrel tanks. Parts produced with this solution were bright, fairly smooth, but not as uniformly covered with zinc as was commercially desired. This solution is used today for the zinc plating of cast iron parts and is performing satisfactorily. In its operation very little control has been found necessary. The solution is kept very mildly acid with H_2SO_4. Corrosion of anodes is very good, current efficiency is high and color is excellent. It is necessary to scrub the castings during operation in order to remove graphite and sand from corners and pores.

For the finishing of other iron and steel parts our attention was attracted about 10 years ago to zinc cyanide and cadmium cyanide solutions. We found after investigation that the cyanide solution produced deposits of fairly good color, smooth and uniformly distributed, all of which were highly desirable to us. These deposits were compared with deposits from $ZnSO_4$ solutions by means of the salt spray and also exposure on the roof of our building located at the near west side. This was con-

sidered an industrial atmosphere and one which would simulate many atmospheres where our apparatus would be located.

The weight of plating used in the majority of cases is specified at the minimum of 50 mg. of zinc per square inch of surface. This is approximately 1/4 oz. per square foot. A deposit of this type can stand very readily 48 hours in aerated water and, in the case of ZnCn deposits, 200 hours in the salt spray. The resistance afforded by a deposit of this weight to salt spray corrosion depends of course, to some extent with the nature of the piece. For many of our tests we use a piece of iron 1" wide with a sharp right angle bend.

In our experimental work we found that the spray tests indicated that resistance to corrosion varied in the following order, the best being first.

1. Cadmium from Cadmium Cyanide Solution.
2. Zinc from Zinc Cyanide and Hg. addition solution (about 2% Hg).
3. Zinc from Zinc Cyanide solution.
4. Zinc from Zinc Sulfate Solution.

Roof exposure tests ranked the finish in this order:

1. Zinc from Zinc Cyanide plus Hg. addition solution.
2. Zinc from Zinc Cyanide solution.
3. Cadmium from Cadmium Cyanide solution.
4. Zinc from Zinc Sulfate solution.

Numerous other investigations have been made at various times by other investigators to compare the merits of zinc and cadmium for the protection of iron and steel. In the Bell Laboratory Record of January, 1933, there appeared an article stating the results of some tests carried out by them. They say briefly as follows:

"Metallic coatings may protect the ferrous base metal in two ways: mechanically, by forming a continuous envelope around the steel and so exclude the corroding environment; electrochemically, by being attacked preferentially. The ideal coating would be one which would not be attacked in the corroding environment and which would form a perfectly continuous envelope over the steel.

"In general for outdoor exposure it is desirable nevertheless that the coating be of a metal which is anodic to air, since this

will prevent the appearance of brown stains due to rusting of iron at pinholes. Zinc and cadmium are two metals which are anodic to iron and steel in ordinary environments — Nickel, tin, lead, etc., coatings become stained with air.

"Zinc is one of the earliest and at present the most widely used protective coating. Recently cadmium has had rather wide use as a protective coating.

"Samples were tested by the Bell Laboratories in New York where severe conditions are met with due to pollution and dampness — for more than 3 years samples of steel have been corroding. Another set of samples has been exposed to an excessive rainfall simulated by a water spray turned on the samples thrice daily during 8 months without freezing weather. Electrodeposited coatings on steel were zinc, cadmium, zinc mercury alloy and zinc cadmium alloy. Losses in weight were noted every 2 months.

"The rates of corrosion for zinc and cadmium were less than the others. Provided the different types of coatings are adherent, free from pinholes and other porosity, and distributed uniformly, thickness of coating is the chief factor determining its outdoor service life.

"The unalloyed Cd coatings however, weather at twice the rate of the zinc coatings. It appears as if the best field for Cd as an outdoor finish for steel is in exposure to atmospheres prevailing on the sea coast as salt spray tests show Cd to be better than zinc."

C. D. Hacker in 1934 at an A. S. T. M. meeting in Washington reported on outdoor exposure tests conducted by the subcommittee A-5 on field tests of metallic coatings. 700 hardware specimens had been exposed for four (4) years beginning January 1929, at Altoona, Pa., Pittsburgh, Pa., Sandy Hook, N. Y., Key West, Fla., and State College in Pa. The types of hardware specimen included angles, screws, hinges, nipples, and clamps, all of which were made of steel. The cadmium coatings on the specimens under test were showing themselves inferior in protective action to zinc coatings at all five (5) locations, and for all comparable weights of coatings. The two finishes were compared in groups of coatings weighing 0.14 to 0.67 oz. per sq. ft. At this same meeting of the A. S. T. M. in 1930, R. F. Passano

reported on hardware specimens which were both zinc and cadmium plated. He said: "The impression one gets is that zinc coatings of a given weight last longer than cadmium coatings of the same weight. The magnitude of the difference varies, no doubt, with the location."

In 1930 some loss of weight data were published on cadmium and zinc coatings exposed in New York City. These data showed that cadmium weathered at 2.6, the rate at which zinc did.

The test now in progress on electroplated coatings prepared by the Bureau of Standards shows that a .719 oz. cadmium coating has given about the same service as a .238 oz. zinc coating in this locality. In a recent issue of the MONTHLY REVIEW there appeared an article by Blum, Strausser and Brenner giving a summary of protective value of plated coatings on steel, and their conclusions were as follows:

"1. In all atmospheres thin coatings of either zinc or cadmium furnish better protection against corrosion than thin coatings of copper, nickel and chromium.

"2. In an industrial atmosphere cadmium lasts only about 2/3 as long as an equal thickness of zinc.

"3. In 2 years there has been practically no failure of even thin coatings (0.00002") of either zinc or cadmium in marine or rural exposure.

"Cadmium coatings of a given thickness last much longer than zinc in salt spray or intermittent immersion, but this result has no bearing on their relative value in an industrial atmosphere."

As a result of our original tests in 1927, we felt that the use of zinc cyanide solution would be most advantageous provided we could obtain and maintain satisfactory colored deposits.

While these conclusions were arrived at several years ago, it is interesting to note the results of later investigations comparing zinc deposits with cadmium deposits.

After our tests along about 1927 and 1928, when we found that zinc cyanide solutions produced a deposit of exceptionally good protective value, we made further investigation to determine which composition of solution would give the most satisfactory

results. The work done by Horsch and Fuwa at the Massachusetts Institute of Technology on Current Efficiency and Throwing Power was particularly valuable. They recommended, after considerable investigation, the following solution.

Solution No. 9 — Cyanide D

NaCn	53	grams	per	liter	— 6.1	oz.	per gallon
ZnCn	59	"	"	"	— 7.9	"	" "
NaCH	43	"	"	"	— 5.6	"	" "
$NaCO_3$	9.5	"	"	"	— 1.27	"	" "
$Al_2(SO4)_3$	4.7	"	"	"	— .63	"	" "
Lignol	11.8	"	"	"	— 1.6	"	" "

The current efficiency of this solution was found to be about 83, it had good throwing power, and the deposits were uniform and even in color. Dr. Wernlund in the 1921 issue of the Transactions of the American Electro-Chemical Society recommended the following solution for giving a uniform bright color.

Zinc cyanide — 8 oz. per gallon — 60 grams per liter.

NaCn	7	"	"	"	52.5	"	" "
NaOH	1-2	"	"	"	7.5-15		" "
Na_2CO_3	4	"	"	"	30		" "
NaF	1		"	"	7.5		" "
Corn Sugar	1		"	"	7.5		" "
Gum Arabic	.125		"	"	1.1		" "

He also drew the following conclusions regarding relative salt spray resistance of deposits from zinc sulfate and zinc cyanide solutions. Zinc deposits of .1 oz. per sq. foot from a cyanide deposit are amply sufficient to withstand a 40 hour salt spray test. On the other hand .12 to .24 oz. of zinc per sq. ft. were neccessary when plated from a zinc sulfate deposit.

In 1924 in the American Electrochemical Society Transactions, Dr. Wernlund suggested the use of the following solution.

Zinc cyanide — 5 oz. per gallon
Sodium " — 3 " " "
" hydroxide — 4 oz. per gallon.

The solution was to be operated using electrolytic zinc anodes containing 2% of mercury. He summarized his investigation

as follows: That one pound of zinc mercury alloy deposited from the improved zinc cyanide solution furnished as much protection against corrosion as 1-1/4 pound deposited from the ordinary cyanide solution or from 2 to 4 oz. deposited from the zinc sulfate solution.

Further, he stated that zinc mercury anodes in the zinc cyanide solution produce a light, silvery colored deposit consistent, free from porosity and less re-active chemically than other zinc deposits and do not stain or discolor appreciably during exposure.

Mr. A. Pearson of the Western Electric Co. in a MONTHLY REVIEW of 1925, had an excellent paper on the practical operation of a zinc solution. He suggested the use of the following composition:

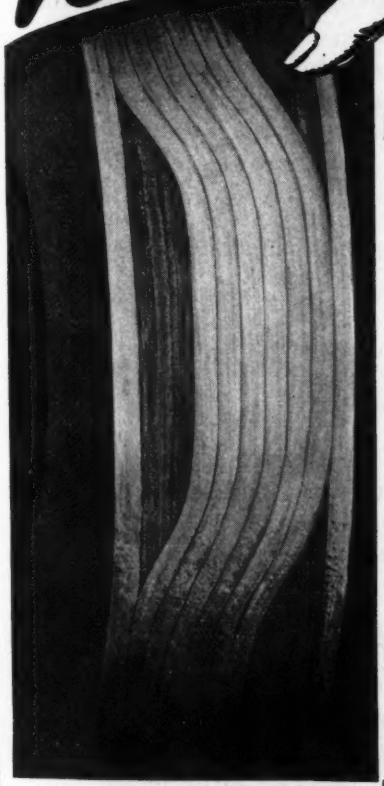
Zinc cyanide	7.75 oz. per gallon
Sodium Cyanide	6.75 " " "
Sodium hydroxide	1.30 " " "
Sodium carbonate	none
Gum arabic	.04 " " "
Sodium fluoride	.97 " " "
Temperature	119° F
Current density	15 amperes per sq. ft.
Current efficiency	94.1
Throwing power	Good

He concluded that fairly wide range of solution composition produced good results although it was necessary to continually add the addition agents to produce good color.

After making investigations regarding the properties and merits of these various solutions, we concluded to set up a zinc cyanide solution for commercial production. The solution given below was adopted — first because it was fairly simple in composition and contained a minimum of constituents to maintain. Second, because it had high current efficiency. Third, fairly good throwing power, and fourth, and very important, it produced a deposit with a good bright color;

Zinc cyanide	7.24 oz. per gallon
Free cyanide	2.63 " " "
Sodium hydroxide	4.96 " " "

Now!



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This was operated at a current density of approximately 20 amperes per square foot at a temperature of approximately 115° F. 75% electrolytic zinc anodes containing 2% mercury were used along with 25% straight electrolytic anodes. Electrolytic anodes contained a minimum of 99.9% zinc. This solution is used with fairly good results as far as operating characteristics were concerned. However, we did have trouble in obtaining uniformly good color.

We therefore, changed to a solution of the following approximate analysis:

Zinc cyanide	4.34 oz. per gallon
Sodium cyanide	3.65 " " "
Sodium hydroxide	6.16 " " "

We also changed the composition of the anodes. These anodes met the following specifications:

Iron — not over 0.25%
Lead — not over .80 %
Cadmium — .15 to .25 %
The balance was zinc plus 1% of mercury.

A lower concentration of zinc is conducive particularly to better color. However, in operating at 20 amperes per square foot, it is inadvisable to lower the zinc content below 2.5 oz. per gallon as considerable gassing results and rate of deposition is decreased.

This solution has been operated for a number of years in a large moving cathode system, using 4000 gallons of solution. It has been necessary to maintain composition by very frequent analysis. Anodes have to be removed and cleaned frequently. Also sludge removal is quite necessary. Filtration is carried out continuously as fine insoluble particles settle in the work producing bright spots and also rough deposits. Carbonates have to be removed if they run too high as they tend to coarsen the deposit. The carbonate content has run as high as 12 oz. per gallon. This has been reduced in several ways. The solution has been cooled to about 20° F and the carbonates precipitated and are removed by filtration. This, of course, cannot be done in the summer time. We have precipitated the carbonate with lime. This is fairly satisfactory, although the hydroxide

content is increased considerably. Therefore, the use of lime is limited.

While the above mentioned cyanide solutions and anodes when carefully maintained produce when originally plated, a bright deposit, there is a tendency for them to discolor rapidly. Investigation has indicated that the mercury deposited along with the zinc changed color more rapidly than the zinc alone. This is objectionable where new parts are assembled into apparatus along with old parts. Therefore, it became necessary several years ago to eliminate the use of 1% mercury in the anodes. At that time a higher purity zinc anode was put into use, the analysis of the anodes is as follows:

	Min.	Max.
Zinc	99.25%	
Iron		.10%
Lead		.30%
Cadmium		.50%

A typical analysis of the solution at that time is as follows:

Zinc cyanide	2.81 oz. per gallon
Free cyanide	6.16 " " "
Total NaOH	5.22 " " "
Na_2CO_3	8.07 " " "

This solution produced a smooth uniformly distributed deposit, which had a bluer color than when the 1% mercury was in the anode. It was found that this deposit was very sensitive to rinsing, i.e., it was extremely necessary to very thoroughly rinse and quickly dry in order to prevent appreciable discoloration. This procedure involved so much difficulty in operating with a mechanical cycle of plating rinsing and drying that it became necessary to make another change in the solution.

The change made involved the use of addition agents. Gum arabic and sodium fluoride have been selected as giving the most satisfactory color both as the parts leave the plating machine and also after ageing. The composition of the solution as used at the present time is as follows:

Zinc	19 grams per liter (zinc cyanide)
NaCn (total)	49 " " "
NaOH (net)	14 " " "
Na_2CO_3	47 " " "

In terms of ounces per gallon, these figures are equivalent to:

Zinc cyanide	4.7 oz.
Sodium cyanide	2.6 "
Sodium hydroxide	2.0 "
Sodium carbonate	6.3 "

The limits of composition that seems to give the best results particularly from the standpoint of color, is as follows:

Zinc cyanide	4 to 5 oz. per gallon
Sodium cyanide (free)	4 to 5 " " "
Sodium hydroxide	3.5 to 4.5 oz. per gallon
Sodium fluoride	0.5 to 1.0 " " "
Gum arabic	.1 to .15 " " "

To maintain this composition very frequent analyses were necessary, also frequent additions of plating salts. There is a tendency for the zinc content to rise which is partly counteracted by the use of steel anodes. The addition agents are added quite often, the chief guide being a darkening of the deposits as they leave the tank. Change in color in stock rooms and in service is minimized by using large amounts of rinse water both hot and cold, also quick drying is accomplished with blowers placed above the hot rinse water.

Some recent experimental work done has quite definitely indicated the ability to produce zinc deposits that will retain their color without change for considerable periods of time. It has been shown that rinsing with considerable volume and pressure, using a spray, is considerably better than the use of a large number of short dips in fresh water. We believe further experimental work along this line will prove of immense benefit.

In barrel plating we use a solution of about the following composition:

Cyanide — 9-12 oz.
Free cyanide — 8-10 oz.
Sodium cyanide — 4-6 oz.
Sodium carbonate — 0-8 oz.
Temperature 120° F — 9 volts.

Carbonates run as high as 10 oz. per gallon without having much detrimental effect. The color obtained in the barrel is

not as satisfactory as that from the still tank. The current efficiency is fairly high in the barrel apparatus we now use. On some parts we get better than 80%. The throwing power is good as determined by a Preece test.

In concluding this paper, we summarize the advantages of zinc plating as follows:

1. Low cost of zinc anodes.
2. Good throwing power.
3. Good current efficiency.
4. Good bright color that changes fairly slowly provided rinsing is very thorough and parts are dried quickly.
6. High resistance to all types of atmospheric agencies.

The greatest disadvantage is the need for careful maintenance with the resultant increase in expense, particularly where demands for good color immediately after plating and in installed apparatus are great.

Membership Report

To June 18, 1935

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Some Aspects of Research in **Electro-Deposition** *in Great Britain*

By D. J. MACNAUGHTAN, F. Inst. P.,
President, Electrodepositors' Technical Society of Great Britain

Presented at a joint meeting of the Philadelphia Branch, American Electroplaters' Society and the Philadelphia Section of the Electrochemical Society February 28, 1935

Sent to the MONTHLY REVIEW by the courtesy of Dr. E. B. Sanigar and Philadelphia Branch

A YEAR ago, during my first visit to this country, I was invited to speak before the American Electro-Platers' Society. Much to my regret it proved at that time quite impossible for me to fit this in with my other engagements. I am, therefore, glad to be afforded a further chance of addressing you during this, my second visit to your country, more particularly as it gives me an opportunity of conveying to you the greetings of the Electro-depositors' Technical Society, of which I have the honour to be President. This Society has very similar objects to those of the American Electro-Platers' Society, although it is organized on somewhat different lines; the activities and publications of your Society are, therefore, of great interest to us in Great Britain. The Electrodepositors' Technical Society was founded in 1925 shortly before the application of chromium plating became widespread and it has undoubtedly been instrumental in bringing electroplaters into touch with each other and with the results of the many recent scientific investigations in electrodeposition. The Society has from the first been closely associated with the Faraday Society, which is somewhat analogous to your Electrochemical Society, and it is of especial interest to me that members of that excellent institution are also present tonight. The Faraday Society takes much interest in the more fundamental problems of electrodeposition, as is shown by its forthcoming general discussion on the structure of metallic coatings which is to be attended by investigators from several European countries and by Dr. Blum from the U. S. A.

Although I should like to give a detailed account of research on electrodeposition which has recently been published in Great Britain, I fear this is impossible in the time at my disposal and I propose to review briefly the gener l trend of the work and then deal in greater detail with some aspects of it with which I have been more closely connected.

Electrodeposition research in Great Britain is chiefly carried on by the supply houses, large industrial firms, Government departments and, to a small extent, in universities and technical colleges. The interests of these bodies are diverse and thus naturally the lines of investigation have been diverse.

In general, study of the technique and application of electroplating have formed the subject of the work of the supply houses and the large industrial firms. Imperial Chemical Industries have sponsored work on cleaning procedures and have been instrumental in introducing to the electroplating trade the solvent vapour method of degreasing. The International Nickel Company, through their Bureau of Information, have done great service to the electrodeposition industry by publications and abstracts on nickel. Much interest has also been aroused by the introduction of the platinum group of metals, including rhodium and palladium into the industry and a number of papers have been published on these subjects.

The work so far described is necessarily not of a fundamental nature. The Department of Scientific & Industrial Research, a government department charged with the prosecution of research work of a fundamental nature such as is unlikely to be undertaken by private firms, felt about 1925 that there was need for such work in electrodeposition. Since, during the War a good deal of interest had been taken in electrodeposition by the British War Office, Admiralty and Air Ministry, it was felt that much of the information already available in the Service Departments, apart from confidential matter, might be developed along lines useful to the electroplating industry. When, therefore, an electrodeposition research committee was set up and funds allocated, a large portion of the work was allotted to the Research Department, Woolwich, and the Royal Aircraft Establishment, Farnsborough. Other work was also carried out in the metallurgical department of Sheffield Uni-

versity. The British Non-Ferrous Metals Research Association, an organization of industrial firms in the metal trade for co-operative research, also financed investigations in electro-deposition of a general nature. The results achieved by these two bodies have borne fruit which is now being generally recognized and the D. S. I. R. has decided that for the future the work must be directed and, at least partially, supported by the industry alone; they have accordingly handed over the control to a Special Committee of the B. N. F. M. R. A. More recently The International Tin Research Council have also undertaken research in electrodeposition of tin and cognate problems.

The co-operative research of the United States Bureau of Standards and the American Electro-Platers' Society and the valuable results so obtained have been of very considerable interest to those connected with these endeavours, more especially as nothing similar appears to have been undertaken in Continental European countries.

Now the centres at which the fundamental research has been carried out in Great Britain have been primarily metallurgical centres, and the problems have thus been treated from a metallurgical point of view. Previously, electrodeposition has very largely been viewed from the electrochemical side, as is only natural, but it must not be forgotten that the final product is a metal and must be judged from a metallurgical standpoint. Thus examination of the microstructure, Brinell Hardness number, or of other mechanical properties forms the only satisfactory criterion of the value of a deposit for a specific service, and the only quantitative method of studying effect of change of the conditions of deposition. This method of examination is more tedious and slow than the visual examination of thin deposits since comparatively thick deposits are essential; the results obtained, however, have amply justified the labour involved.

In general metallurgy the Brinell hardness test, which consists in measuring the indentation produced in a metal surface by a hard steel ball under a given load, has, in many applications, been found to afford a reliable guide to the mechanical properties of metals. In view of its comparative simplicity it was selected by the investigators at Woolwich as a means of

studying the effect of variation of the electrochemical conditions on the mechanical properties of electrodeposited metals. It was found with electrodeposited, as with metallurgically produced, metals that the Brinell hardness number was a definite guide to the fineness of the crystal structure, the ultimate tensile strength and also, in general, to the ductility of the metal. These researches have shown that the range of hardness of most electrodeposited metals is greater than can be obtained by preparation of the metals by other methods; in some instances, for example electrodeposited copper, the lowest hardness obtainable is equal to that of the fully annealed metal; in other instances, particularly with chromium, nickel and cobalt, this is not so.

Hardness of Nickel Deposits

The structure and mechanical properties of nickel deposits have long been known to vary over a very wide range, and to be extremely sensitive to the conditions of deposition, such as the acidity of the solution, but the cause of these variations was not clearly understood.

Quantitative study of the hardness of nickel deposits shows that with both the two chief types of nickel depositing solutions in commercial use; viz. the so-called "single salt" type, containing nickel sulphate, boric acid and a chloride, and the "double salt" type, containing nickel, ammonium sulphate and a chloride: the Brinell hardness number at fixed current density and temperature falls rapidly with increasing acidity to a critical value and then markedly increases. Tentative explanations of this variation previously put forward, of which the most widely accepted was that it resulted from the variation in the amount of co-deposited hydrogen, were found untenable. Metallurgical study of the problem revealed that change of hardness was bound up with change of grain size. O'Sullivan had indeed already concluded that co-deposited oxides were the cause of the sudden changes in grain size and hardness with increase of acidity, and had attempted, with inconclusive results, to detect their presence by chemical analysis. It has now been established by a systematic study, using quantitative methods, that the structure and mechanical properties of nickel deposits are controlled by the method of development of the crystal structure during

deposition; where the structure is coarse, a relatively soft and ductile deposit results, where it is fine a hard and brittle deposit, frequently containing cracks, is produced. The difference in structure observed under different conditions of deposition is due to interference with normal crystal growth caused by the inclusion in the growing metal of basic nickel compounds which are formed in a colloidal state in the liquid at the cathode face as a result of local reduction of acidity by hydrogen ion discharge. The quantity of colloidal matter formed, which thus determines the properties of the deposit, is influenced by the type and composition of the depositing solution and in particular by its acidity.

Proof of the presence of non-metallic matter in nickel and certain other deposits has been obtained by high temperature heat treatment of nickel deposits of different hardness; grain growth was found to be restricted to an extent varying with the initial hardness, and non-metallic matter was seen segregated in the grain boundaries. Incidentally the segregated non-metallic matter causes serious brittleness in initially hard deposits after annealing, an effect previously noticed, but unexplained.

Pitting of Nickel Deposits

These researches made possible the selection of the conditions of deposition necessary for the production of nickel deposits of any required mechanical properties within a wide range, thus facilitating their use in electroforming or in the repair of worn or undersized parts, as well as in the more usual applications where the decorative and protective qualities were chiefly desired. Nevertheless, the use of nickel deposits for all these purposes was limited by the frequently occurring defect of pitting, consisting of small approximately hemispherical depressions in the deposit, primarily caused by the shielding action of adherent hydrogen bubbles.

It has been found that in certain instances the defect may be caused by a condition of the basis metal, due to the presence of surface defects such as oxide inclusions, laps, welds, etc. in steel, or spills in brass. If the basis metal is coated with copper, or with nickel followed by copper, prior to the main nickel deposition, the surface defects, in general, no longer cause basis metal pitting.

The main cause of the defect is, however, due to a condition of the depositing solution, and may in this instance be conveniently termed "solution pitting". A correlation of the occurrence of solution pitting with the composition and acidity of highly purified depositing solutions has led to the conclusion that the adhesion of the hydrogen bubbles causing pitting is determined by the amount and physical condition of the basic nickel compounds formed in the solution near the cathode. Thus the occurrence of the defect is due to the same cause as the hardness of the deposit. Nevertheless the two phenomena are only indirectly related. The quantity of basic nickel compound produced in the vicinity of the cathode surface may be approximately calculated for any specific acidity, from a knowledge of the cathodic current efficiency of hydrogen discharge at this acidity and the buffering properties of the solution. When such calculations are made it is found that with increasing acidity the amount of basic compound produced at first falls, but later rises, as the solution becomes appreciably acid e.g. pH 4.0. This paradoxical result is due to the large increase in the rate of hydrogen discharge at the higher acidities, but is in part offset at still higher acidities, e.g. pH 3.0 and below, by the increased agitation of the solution adjacent to the cathode by bubbles of evolved hydrogen gas.

The basic compounds are first formed in colloidal condition and positively charged. If not flocculated by suitable anions they migrate to the cathode and retard grain growth of the deposit which is consequently fine-grained and hard. In the finely divided but flocculated condition, however, the basic material stabilizes the hydrogen bubbles present, increasing their adhesion to the cathode, and causing pits.

Systematic and quantitative study of the effect, on the hardness and prevalence of pitting of nickel deposits, of the presence of each anion and cation in a nickel sulphate, chloride and boric acid solution allows the following conclusions. The absence of boric acid, by reduction of the buffering property of the solution leads, in general, to the production of hard, cracked and lustrous deposits, which are also, in general pitted. In the presence of boric acid and chloride, as is usual in commercial solutions, the deposits are soft over an acidity range of pH 6.0 — 2.0; but

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whilst in the presence of alkali metals they are almost unpitted, in the absence of these ions the defect is severe except at high acidities. In view of the fact that solutions used in practice are frequently prepared with nickel salts only and not with potassium or sodium chloride, this conclusion has an important practical value. A further outstanding result from the practical point of view is the entire absence of pitting on deposits prepared in pure solutions at low pH values (below pH 3.0).

The theoretical significance of the results has been shown, by examination of deposits prepared from similar solutions in the absence of chloride, to be due to the flocculating effect of the chloride ions on the basic matter produced which prevents undue hardening of the deposit but assists pitting. In the joint presence of chloride and alkali metal ions the basic material is flocculated to a less extent and is thus not in a suitable physical form to stabilize the gas bubbles. At relatively high acidities the basic material present at the cathode is small in amount and is quickly swept aside and re-dissolved by the agitation caused by evolved hydrogen gas.

Stress in Nickel Deposits

Nickel deposits prepared at the lowest acidity are extremely hard, frequently lustrous and in general free from pits. It might at first sight appear that this type of deposit would be most suitable for purposes where high strength, great resistance to abrasion or ease of polishing to a bright surface were desired. Micro-examination of the cross section of such deposits, however, shows that they are frequently cracked and are in a highly stressed condition and thus unsuitable for these uses. The cracking is, indeed, the result of the action of the high internal stress on a brittle deposit.

Stress in nickel deposits, especially where the adhesion is not of the highest order, may lead to exfoliation during, or subsequent to, the plating operation and especially during subsequent chromium plating or service under corrosive conditions. Furthermore it has been found in an investigation of the subject that the presence of stress in the thicker coatings applied in the repair of machine parts may reduce their fatigue resistance. Methods for the determination of the stress have, therefore, been developed, consisting in brief of the deposition of nickel

on one side only of a strip of spring steel and measurement of the resulting curvature. An investigation of the whole subject of stress in electrodeposits carried out at the University of Sheffield, resulted in the development of methods for producing unstressed or lightly stressed deposits notably by the use of hot solutions and the superposition of alternating current on the direct depositing current.

Adhesion of Electrodeposits

Another factor of major importance to the successful application of electrodeposited coatings is their adhesion to the basis metal. In the repair of worn or undersized machine parts by electrodeposition of nickel, the adhesion must be comparable with the strength of the deposited metal. Nickel coatings which are subsequently to be chromium plated must also be highly adherent if subsequent exfoliation is to be avoided. Quantitative testing of adhesion by the Ollard method has facilitated the selection of satisfactory treatments. A paper by A. W. Hothersall on the work done on this subject has recently appeared in the Transactions of the Electrochemical Society and hence no further reference need be made here.

Porosity of Deposits

A further defect of electrodeposited coatings which considerably limits their usefulness is the presence of pores, through which corrosion of the basis metal may occur. The detection of porosity in nickel, and other coatings, cathodic to steel thus becomes of major importance in inspection and in the forecasting of the anticipated service.

One of the earliest tests developed was the salt spray test and although this test originally served a useful purpose it has become clear that it has serious disadvantages, chief of which is the difficulty of differentiating between pores initially present and those formed during the test. Investigations of the ferricyanide test show that it also is not entirely reliable owing to the corrosive action of the reagent used. With tin coatings on steel the results are particularly anomalous and it has been

found that under certain conditions of the test the tin became anodic to the steel basis metal and no record of the porosity is obtained.

It therefore became necessary to study the general question of the determination of the porosity of electrodeposited coatings. Known methods were critically reviewed and finally a new and simple method was devised. This test, which has so far been chiefly applied to the study of tin coated steel, consists essentially of the immersion of the carefully degreased specimen in distilled water of suitable purity at 90-9 °C for some hours, when sharply localized and strongly adherent spots of iron-rust appear at the site of pores. It has been shown by this test that electrodeposits of tin on steel less then 0.0005 inch in thickness are, in general, porous, the degree of porosity increasing with reduction in thickness. Deposits thicker than this are sufficiently free from porosity for practical purposes but where a definitely non-porous deposit is required a thickness of not less than 0.00075 inch is necessary.

Electrodeposition of Tin

The production of substantially non-porous deposits of tin on steel from the previously known alkaline tin baths is not possible, for before sufficient thickness is attained the deposit has become spongy and treed. On the other hand, the high throwing power of this type of solution renders it very suitable for the protection of articles of intricate shape. A study of the mechanism of the formation of the spongy growths has shown that they are due to the presence in the solution of bivalent tin ions. Since, however, the anodic solution of tin in sodium hydroxide solutions almost invariably results in the formation of bivalent tin compounds, obviously some method of continuous oxidation is necessary. The work of Oplinger, who has found the use of oxidizing agents in sodium stannate solutions to be beneficial, supports this view. A method by which smooth, matt deposits of any thickness and of high throwing power can be produced from sodium stannate solutions has been worked out, the central feature of which is the use of insoluble anodes of iron or nickel, coupled with periodic regeneration of the tin content of the solution by the use of tin anodes and electrochemical oxidation. A complete recommended method of com-

mercial operation, and methods of analytical control, have been published and render possible a wide extension of electrodeposited tin coatings.

The investigations carried out by Dr. Blum and his associates in this country have always been of very great interest to us in Great Britain and I trust that this necessarily short account of some part of the research work carried out in Great Britain has similarly interested you.

A NEW PLATING UNIT

The electroplating industry has been waiting for a small, inexpensive barrel plating unit to handle occasional handfuls of work or the production plating of small quantities of small parts. Small loads tie up large plating units and increase the cost of production and it is with difficulty that small quantities can be plated in the large barrel platers.

The Udylite Company are about to put on the market a new low cost unit, the Handiplater. It will accommodate any plating solution common to barrel plating operations. The cylinder is detachable, making it possible to use the latter for several plating operations, and the detachable cylinder provides easy manipulation and operation.

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Come Platers and friends, give heed to this call
Make this Bridgeport Convention the greatest of all
Just give me your closest attention.
Don't worry about the eternal how
But live in this great and glorious now
This Wonderful Bridgeport Convention.

You are each of you, all of you, put to a test
Just come out on top with your very best, best,
And you'll have a great time every day
Have a welcome for all and a permanent smile
Be one band of brothers, make this week worth while
Successful in every way.

The program is ripping without any doubt
There's just simply nothing that's missed or left out
It's perfect in every way
Addresses of welcome this day have their share
With an opening speech from his honor The Mayor
And speech making fills out the day.

Then comes changing of by-laws and making revisions
But be sure and comply with Supreme Court Decisions
And never be revolutional
Not only that changes should be for the best
But legal and lawful when put to the test
They must be Constitutional.

The receptive to science the Platers become
And we hear from our dear old friend Dr. Blum
And the Bureau of Standards attainments.
On the action of Acids on steel we then hear
And what causes plating to stick and adhere
Then comes eats and entertainments.

The Bridgeport A. E. S. Convention

(Continued)

Tuesday morning a paper on Black Nickel is read
And we learn to plate Antimonial Lead
And how Barrel Plating is done.
In the coloring of metals we're put up to date
And how Zinc die castings are easy to plate
And then it is time for some fun.

For then comes a time of complete relaxation
With frolic and fun and without education
And a luncheon with nothing to pay.
Tuesday afternoon's program is simply entrancing
Athletics and eats and our ball game and dancing
And a shore dinner ends a great day.

Next in line comes Doc Lukens, he surely is grand
He tells things in a way that we all understand
But then comes some papers that's tough.
It should give a Plater complete satisfaction
To learn all about metal Xray diffraction
But to me 'twould be very deep stuff.

When Tom Slattery next day gives the word to begin
We learn the correct deposition of Tin
And the value of tests of corrosion.
For Doctor Blum shines on all kinds of a test
On this kind of stuff he is right at his best
On inside or outside exposion.

I've just about finished and with my last rhyme
I hope that you'll all have a glorious time
All kinds of enjoyment and fun.
We've had wondrous times in Conventions of Yore
And I just hope that all of you see many more
Good luck to you every one.

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The Abstract Section

T F. SLATTERY, *Chairman, Program and Educational Committee*

The Determination of Sulfuric Acid in Chromium Plating Baths (Die Schwelfelsäurebestimmung in Chrombädern), by M, GÜNTHEL. *Die Metallwaren-Industrie und Galvano-Technik*, Vol 33, No. 7, 1935, 139-142—Most of the published methods for the determination of sulfates in chromium plating solutions have given unreliable results due to a multiplicity of causes. The author hereby reports the results of studies running from Oct. 1927 to 1933 at the University of Leipzig. This abstract is primarily for the careful analytical chemist.

1. Sulfates precipitated from a tri-valent chromium solution in the presence of only HCl by barium chloride will yield low results. In the presence of ferric iron very low results may be obtained, whereas if antimony, bismuth, cerium, or cadmium salts are present, high values result.

2. If the sulfate is precipitated in the presence of acetic acid and HCl, correct values will result only when foreign cations as mentioned above, are absent.

3. If the foreign cations are precipitated by sodium carbonate low results follow.

The lowering of the barium sulfate value is due to the partial precipitation of basic sulfates of the foreign cations which give off SO_3 on heating of the precipitate. Di-valent cations as Cü and Zñ have disturbing effects. If the acid concentration is too low, antimony and bismuth may form oxychlorides when precipitating with barium chloride. From these results it is necessary to remove disturbing cations and to change the chromium sulfate into the true sulfate before accurate results may be obtained. Care must be taken in their removal not to drag out sulfate.

The technique for the removal of disturbing cations and the complete analysis is given but are too long for abstraction.

The routine analyst may be surprised to learn that checks in duplicate analyses are no criteria for accurate determination of sulfates in chromium plating solutions. This article is well worth reading in the original German as it represents a vast amount of careful work on a truly difficult determination.

WALTER R. MEYER

Colored Etching of Letters, Trademarks or Ornaments on Hardware of all Types. (Farbiges Einätzen von Buchstaben, Warenzeichen oder Verzierungen in Metallwaren aller Art). *Die Metallwaren-Industrie und Galvano-Technik**, Vol. 33, No. 8, 1935, 161-162—The customary technique for etching letters, etc., on metal goods was to use a resist of wax and rosin, engrave, and then etch with acids or salts as Ferric Chloride. Coloring would have to be done by subsequent plating or lacquering. Copper sulfate and acids give poorly adherent deposits.

Beautiful adherent etchings can be made by adding a selenium compound and a heavy metal as bismuth to the etchant.

A formula for an etchant for a beautiful black on steel is as follows:

To a liter of one part conhydrochloric acid, 2 parts connitric acid and 3 to 7 parts water is added 100 grams of copper chloride or up to 50 grams of selenious acid.

For high-alloy steels as the stainless steels, selenium is replaced in part by tellurium and only hydrochloric acid is used.

A typical formula follows:

100 grams — 10% HCl
50 grams — Bismuth Selenite
5 grams — Antimony tellurite

The process is not only applicable to steel and alloy steels, but to copper and its alloys, Stellite, zinc, tin, lead, and their alloys. By variation of the components any intensity of color may be obtained. According to the position in the electromotive series of the etched metal, the colored deposit will consist either of the basis metal selenite or of the heavy metal in the etchant such as bismuth.

For copper, brass, or bronze use:
300 grams HCl (Sp. Gr. 1.15)
40 grams Antimony tellurite
80 grams Bismuth selenite
580 grams Water

WALTER R. MEYER

NOTICE

The minutes of the Bridgeport Convention can be obtained from the Secretary

Mr. E. Steen Thompson,
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CHICAGO BRANCH

The regular monthly meeting of Chicago Branch was held Saturday, June 1, at the Atlantic Hotel, President E. G. Stenberg presiding and all other officers present.

Several cards and letters regarding the exhibit at the convention read and placed on file. A new application of Mr. C. H. Buckshorn read and a committee appointed on same. Mr. T. W. DeMott was elected to active membership.

Mr. B. Meyers one of Chicago Branch's Past Presidents installed the new officers for the coming year and Bob made a very fine and impressive job of it.

F. J. Hanlon the chairman of the convention Booster meeting gave a very interesting description of the route, rates and etc., for the members who wish to attend the convention. The meeting was then turned over to Mr. O. E. Servis, the librarian, who stated that due to the length of the meeting it was necessary to omit the question box. Mr. Servis then introduced the guest speaker of the evening, Mr. F. Oplinger of the R. & H. Div. of the E. I. DuPont De Nemours & Co., who gave a very interesting and instructive talk on Brass Plating on Die Castings. Mr. Oplinger's talk started the boys thinking about the new uses that a brass solution could be used for, and the members kept Mr. Oplinger busy answering questions. After this interesting talk and discussion the meeting adjourned, after which cigars, lunch and refreshments were served. This convention Booster meeting was considered a success by all and was enjoyed by a very large attendance.

Elected. T. W. DeMott, 3551 Janssen Ave., Chicago, Ill., Active.

New Application. C. H. Buckshorn, 27 S. Dearborn St., Chicago, Ill., Active.

J. W. HANLON, *Sec.*

HARTFORD BRANCH

The Hartford Branch of the A. E. S. held its May meeting on Monday evening, May 27, 1935, jointly with the American Society for Metals, at the Hartford Electric Light Auditorium Hartford, Conn.

The meeting was called to order at 8:30 P.M., with President St. Pierre in the chair. Minutes of the previous meeting were read and accepted. All communications were read and placed on file. The application of Mr. H. C. Duggan, for associate membership was voted on for publication.

After the close of regular business, Mr. Ray O'Connor, of the Bridgeport Branch, gave us a very interesting talk on what is to take place at the National Convention in Bridgeport. His talk was very interesting, and gave us a good idea of just how much work there is connected with an affair of this kind.

Mr. E. L. Wood then introduced Mr. G. F. Geiger, Research and Development Engineer of the International Nickel Co., of New York, who was speaker for the evening.

Mr. Geiger gave a very fine talk accompanied by many lantern slides on "Nickel — from the Mine to the Depolarized Anode." His talk, as well as the slides, was very interesting. After the discussion and questions which were asked, and answered by Mr. Geiger, he was given a rising vote of thanks.

We were pleased to see many of

our friends and members who came down from Springfield for the meeting.

The meeting was attended by over forty members and visitors and was adjourned at 11:00 P.M.

V. E. GRANT, *Sec'y.*

BOSTON BRANCH

Boston Branch held its last meeting until the fall, Thursday, June 6th, at the American House with President Campbell in the chair. Minutes of the previous meeting were read and approved. Communications read and placed on file, bills read and moved that they be paid.

Delegates to the convention were as follows: Mr. Donald Wood, Mr. Charles F. Campbell, and Mr. Harry J. Lack. Alternates, Mr. J. F. Harney, Mr. A. W. Garrett, and Louis A. Gale. The delegates were impowered to submit an amendment to the proposed constitutional amendment, the amendment to make membership at the discretion of each branch. Motion was made that the branch send the Secretary to the Convention for one day with all expenses.

The following officers were elected for the coming year: President, Donald Wood; Vice-President, Edward C. DeLorme; Secretary-Treasurer, Andrew W. Garrett; Librarian, George Brown, Jr. Board of Managers: Chairman, Harry J. Lack, Louis A. Gale, Charles F. Campbell, Edward T. Erhardt, and Charles O. Hardy. Mr. Wood was inducted into office and asked for the support of all the officers and members and he will try to do what he can to put Boston Branch on top. Meeting adjourned at 10 P. M.

A. W. GARRETT, *Secy.*

WATERBURY BRANCH

Delegates and visitors to the 23rd Annual Convention of the American Electro-Platers' Society held at Bridgeport recently, returned home pronouncing same one of the best ever held. With few exceptions the local manufacturing concerns interested in the plating and finishing line, were represented by one or more men, during the different sessions of the Convention. One of the concerns sent a lady representative. Special interest was displayed in the Exhibit at the Temple Mosque, and all agreed that it was the best ever presented by the A. E. S.

Walter Fraine, treasurer of the Research Committee, found time whilst in Connecticut, to pay a visit to Waterbury, where many years ago, he was connected with the plating department of the Waterbury Button Co. Another former Waterburian, who found time to visit his home town, was

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Patrick J. Sheehan, now connected with the Cutler-Hammer Co. of Milwaukee, Wis. Mr. Sheehan was elected 2nd vice-president of the Supreme Society at the business session of the Convention; and gained further honors by winning the fat man's race, at the outing held at Seven Gables.

The many friends of Dayton P. Lasher will be grieved to learn of his death, which occurred in this city, June 17th. Mr. Lasher leaves a wife and one son. He had been employed for 45 years by the Waterbury Button Co., being foreman plater. He was a member of the Bridgeport Branch, A. E. S., and also, the Holy Name Society of St. Francis Xavier's Church. He was a frequent visitor at the meetings of the local Branch, and will be greatly missed. WM. F. GUILFOILE, *Secy.*

NEW YORK BRANCH

A regular meeting of New York Branch was held on May 24, at which time the following nominated officers were elected: President, John Rolfe; Vice-President, Ralph Liquori; Secretary-Treasurer, Frank MacStoker; Recording Secreatry, Arthur Wallace; Librarian, Arron Englander; Sargeant-at-Arms, Samuel Goldstein; Assistant Sargeant-at-Arms, Henry Bernstein. These officers were duly installed by our founder, Mr. Charles Proctor, at our June 7th meeting, at which time refreshments were served with plenty of cooling beverage.

It is fitting at this time to pay tribute to a brother like Arthur Grinham, who though in far-off Australia for quite a few years, has certainly exemplified the spirit of good fellowship, by keeping in constant touch with his Branch and friends.

A motion was made and carried to hold one meeting a month during the summer months and to create an educational board under the chairmanship of the Librarian to serve the members in between meetings or in case of immediate assistance. This to better carry out the concepts of this Society—"the dissemination of knowledge."

It is with deepest regrets that the Branch announces the death of Martin B. Apy on May 20, a member of long standing in the A. E. S. and a member of Electrotypers' Union No. 100, of which he served as President for eighteen years. A truly noble character who gave unstintingly of his time and service to the benefit of his fellowman. ARTHUR WALLACE, *Rec.Sec.*

Report of of Special Meeting of N. Y. Branch, A. E. S. Held on Friday, June 7th, 1935, at World Bldg., Park Row, N. Y. C.

The New York Branch held a special meeting the night of June 7th, brought forward from June 14th, to enable the founder of the Society, Mr. Chas. H. Proctor, to install the newly elected officers and delegates to the National Convention just prior to the Convention being held.

The meeting was addressed by several of the outstanding members of the Branch on various subjects. Mr. William Schneider of the R. & H. Chemical Div. of the Dupont Company was there in good voice and Bill Voss of the Fred Gumm Chemical Co. was much in evidence. The founder of the Society, Mr. Chas. Proctor, spoke in a serious vein and also installed the officers for the ensuing year. It was a night well spent, something to remember in the days to come. It was 12:00 o'clock Midnight when the meeting broke up. There were two applications presented for membership in the Society at this meeting.

F. J. MACSTOKER, *Sec'y*

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